A Scranton Gillette Publication

AUGUST 1958

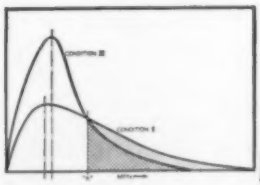
WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
TOMP

At Eau Claire, Wis., Chemist L. V. Owens found that SPLIT FLOW TREATMENT of the ground water supply solved an iron and manganese problem. p. 311.

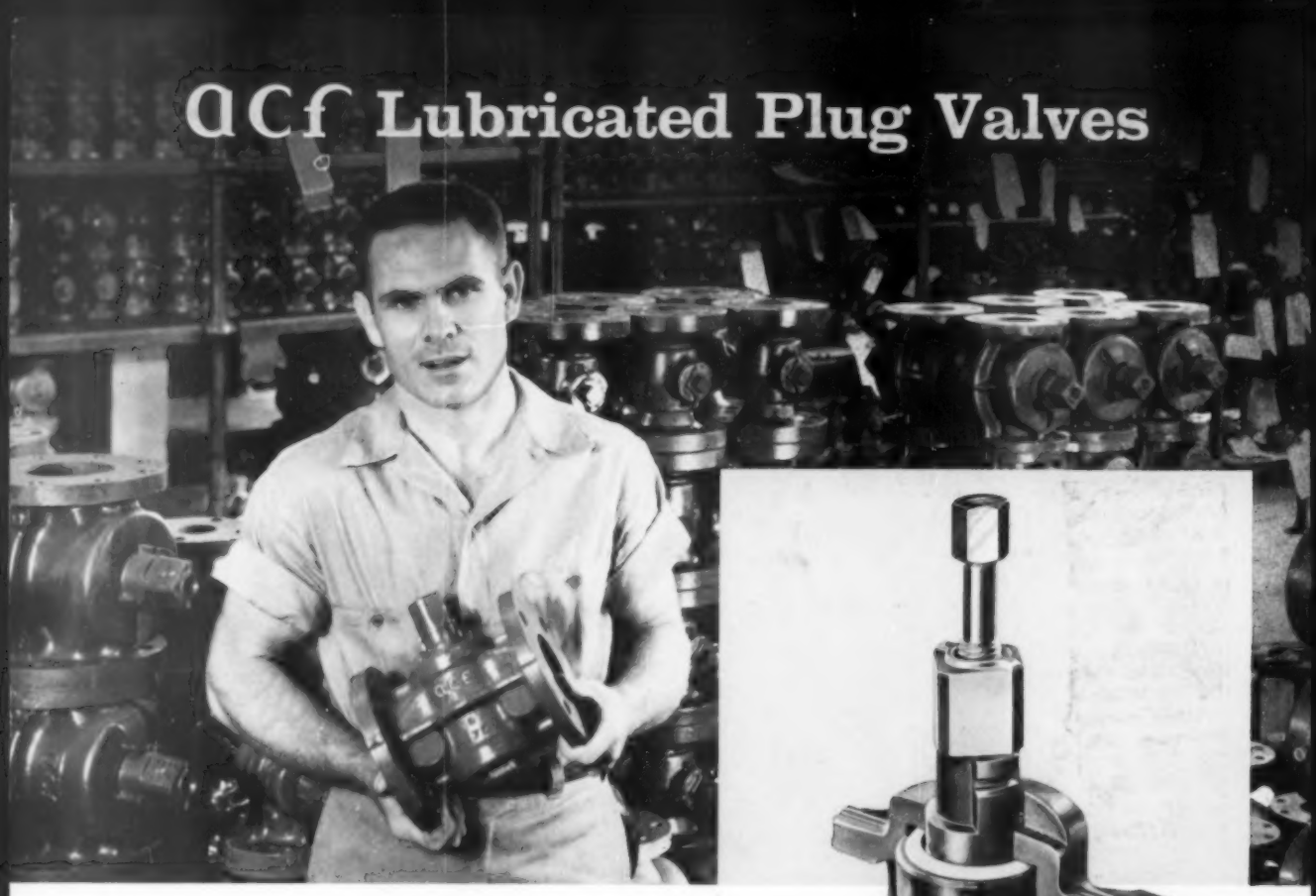
At Las Vegas, Nev., an ALUMINUM COVER on the water reservoir cut evaporation losses and solved a critical water shortage problem. p. 317.



As a yardstick of pollution, the MPN COLIFORM INDEX, determined by the dilution technique has several limitations which weaken its importance. p. 334.

TURNPIKE SERVICE AREAS need sewage treatment plants. High rate trickling filters have been found to be advantageous on the Indiana Toll Road. p. 349.

ACF Lubricated Plug Valves



The most versatile valve your supplier has on hand

The ACF Lubricated Plug Valve demonstrates its versatility by operating efficiently and economically in a wide range of service applications: in chemical plants, sewage and water works, paper mills, oil field production, refining, mining operations, coke plants —it's a long list.

The valve can be installed in any position and it fits into the smallest possible space. It can be serviced quickly and requires minimum attention. It operates easily with a quarter-turn. It is safe against rupture. Due to its efficient lubrication system, corrosion is reduced to a minimum.

Both rectangular and round port valves have full pipe area openings: provide through-conduit flow with minimum turbulence, and minimum pressure drop.

. . . And W-K-M's creative engineering assures standards of design, dependability, and economy that meet your own engineering criteria.

a product of

W-K-M's

Creative Engineering

Semi-steel • Ni-resist
Carbon Steel
Bronze • Aluminum
Multiport • Round Port Opening
Steam Jacketed Base Plate
Venturi
V-Port and Diamond Port
Proportioning • Throttling

Write for Catalog 400

W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

5807

Clay Pipe for— Long-Range Economy

MADISONVILLE, KENTUCKY, is so efficiently managed that for the third successive year no property taxes were levied. With this record for efficiency, it is only natural that corrosion-proof Clay Pipe was chosen for the city's new sewerage expansion program. More than twenty-two and a half miles of Vitrified Clay Pipe are going into the project.

In the opinion of J. Sanders Parker, Consulting Engineer, Clay Pipe is "the best that could be obtained for this service." Clay Pipe never wears out . . . does not rust, rot, or disintegrate . . . is the only pipe backed by a long-term written guarantee. And the new stronger, longer lengths speed installation . . . cut labor costs.

When investigating materials for sewer expansion, remember . . . substitute pipe may have *some* of the features of Clay Pipe, but only Clay Pipe has *all* the features you can trust.

Public Officials: David Parish, *Mayor;* A. O. Johnston, *Councilman, Chairman of Water and Sewers.*

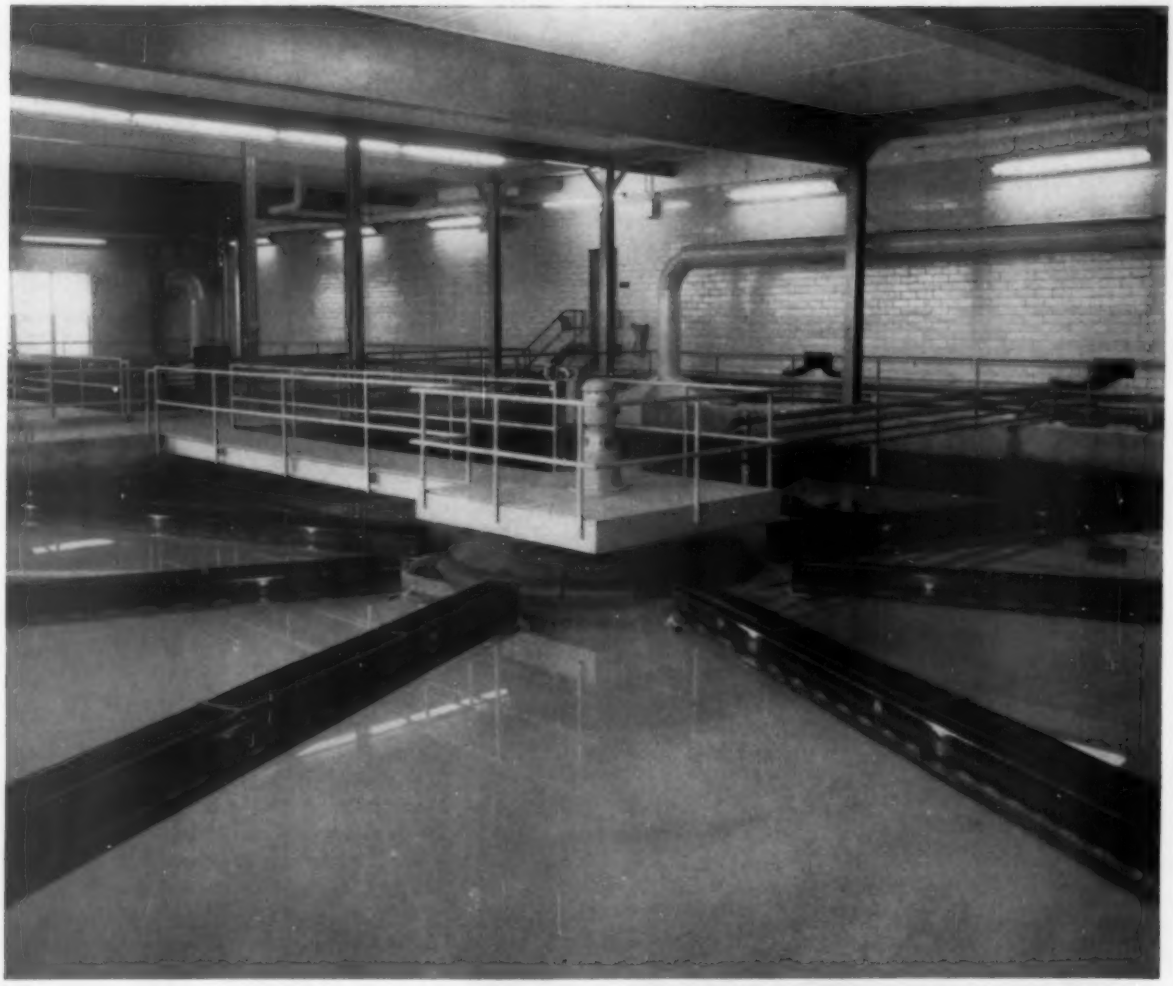
Consulting Engineers: J. Sanders Parker; F. E. Stepp, *Resident Engineer.*

Contractors: C. F. W. Construction Co., Inc.; Sterrett Construction Co.

C-458-1

Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1820 N Street, N. W., Washington 6, D. C.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 703 Ninth & Hill Bldg., Los Angeles 15, California • Box 172, Barrington, Illinois • 286 Mark Bldg., Atlanta 3, Georgia



Two Permutit Precipitators treating 12 million gpd at the Eagle Point Water Plant, Dubuque, Iowa. Plant designed by Consoer Townsend & Associates, Chicago, Ill.

The raw water's loaded with problems, but

Dubuque gets 100-hour filter runs with Permutit Precipitators

Influent at Dubuque's new Eagle Point water treatment plant is loaded with iron, manganese and a hardness of 320 ppm. When you're working with raw water like that, the chances for long filter runs would ordinarily be slim.

Yet two vertical Permutit *Precipitators* hold their blankets effectively even while handling the precipitates from this highly mineralized raw water. The effluent they produce is so low in floc-carryover that very little load is placed on the filters. Result: Getting 100-hour filter runs is no problem at all. Precipitation is complete, and there's no troublesome lime build-up on the filter sand.

The high efficiency of the *Precipitator's* unique upflow sludge blanket has shown up fast in low operating costs for the Eagle Point plant. Long filter runs mean less treated filter wash water is used, hence pumping and chemical costs are both reduced.

Permutit can help you come up with the right answer to your community's water problems. Just contact the Permutit office listed in your phone book. Or write to us directly. The Permutit Company, Dept. WS-8, 50 West 44th Street, New York 36, New York, or Permutit Company of Canada Ltd., Toronto 1, Canada.

PERMUTIT®

rhymes with "compute it"
a division of PFAUDLER PERMUTIT INC.
Water Conditioning
Ion Exchange • Industrial Waste Treatment

Vol. 105 No. 8

AUGUST • 1958

A Scranton Gillette Publication

E. SCRANTON GILLETTE
Publisher

GEORGE E. SYMONS, *Ph.D.*
Editor

•

Contributing Editors

J. R. Baylis
P. D. Haney
L. L. Hedgepeth
C. E. Keefer
R. E. McKinney
R. C. Merz
A M Rawn
R. W. Simpson

•

CHICAGO OFFICE: 185 N. Wabash Av.

E. S. Gillette, Publisher
H. J. Conway, Adv. Ed.
W. W. Hamilton, Western Sales Mgr.
E. C. Heath, Sales Repr.
M. C. Barr, Subscription Mgr.
R. J. Rooney, Makeup Editor

•

NEW YORK OFFICE: 155 East 44th St.

Editorial

George E. Symons, Editor
F. C. Maurer, Associate Editor
J. S. Grumbling, Associate Editor

•

Business

T. M. Todres, Administrative Assistant
Wm. R. Joyce, Midwestern Sales Mgr.
Terence McCoy, Sales Rep.

•

85 Post Ave., San Francisco 4, Calif.

Duncan A. Scott & Co.

1901 West 8th St., Los Angeles 5, California

Duncan A. Scott & Co.

•

1201 Forest Lane, Birmingham 9, Ala.

Fred W. Smith, Sales Rep.

•

Published and Copyrighted 1958 by Scranton Publishing Co., Inc.

•

WATER & SEWAGE WORKS is published monthly with an extra issue in August. Subscriptions including the Reference Number in the U.S. and Canada, 1 year $5.00; 2 years $7.50; 3 years $10.00. Other countries $1.50 a year additional. Single copies 50c except Reference Number $1.00.

E. Scranton Gillette, President; George E. Symons, Executive Vice President; C. T. Gillette, Secretary; and H. J. Conway, Treasurer.

•

WATER & SEWAGE WORKS, Reg. U.S. Patent Off. Published monthly by Scranton Publishing Co., Inc., at 1600 N. Main St., Pontiac, Ill. Entered as second class matter at the post office at Pontiac, Ill., under Act of March 3, 1879.

WATER & SEWAGE WORKS

SPLIT FLOW TREATMENT *at Eau Claire, Wis.*
by Lloyd V. Owens 311

ALUMINUM COVERED RESERVOIR *relieved water shortage*
by W. C. Renshaw 317

WATER PURIFICATION, *distribution, and resources—*
AWWA meeting report—Part III 319

RADIOACTIVE CONTAMINATION *of water—*
Nuclear Congress meeting report **by G. H. Teletzke** 331

RESPONSIBLE WATER USE POLICIES—*Southern Municipal and Industrial Waste Conf. meeting report*
by Charles M. Weiss 332

MPN COLIFORM INDEX *as a yardstick of pollution*
by E. J. Laubusch 334

ALGAE EFFECTS *on D.O. and B.O.D. — Part III*
by A. F. Bartsch 339

CHLORINE VALVE, *hydraulically operated*
by J. R. Rossum 342

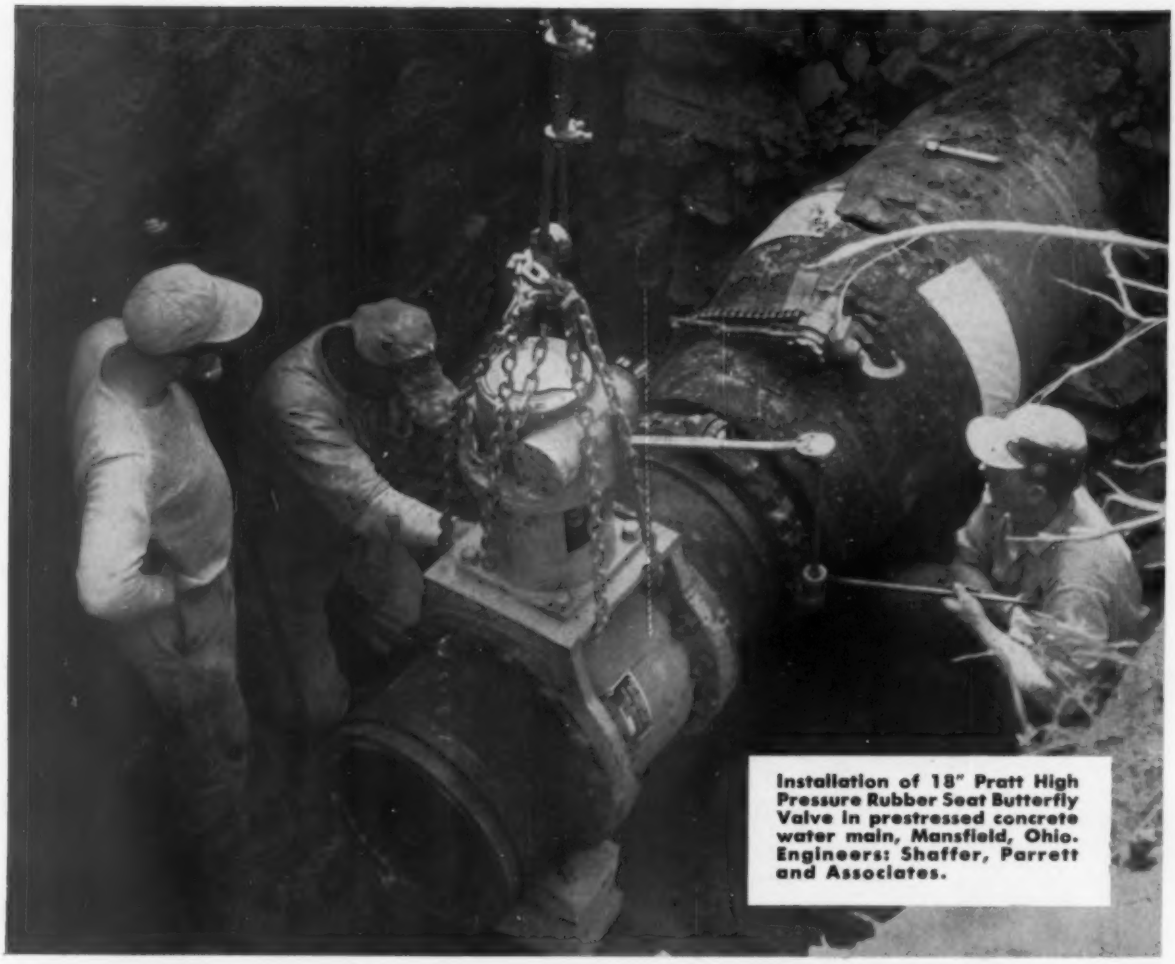
TURNPIKE SERVICE AREAS *sewage treatment*
by W. F. Middleton 343

ASPHALT PAVED SLUDGE BEDS *in Salt Lake City*
by W. T. South 347

TRIBUTES *to Linn H. Enslow* 349

THE EDITOR'S COMMENTS 354

News — Here & There	7A	Meeting Calendar	92A
Equipment News	11A	News of Suppliers	100A
New Bulletins	22A	Helpful Free Literature	110A



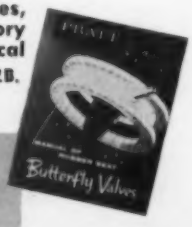
Installation of 18" Pratt High Pressure Rubber Seat Butterfly Valve in prestressed concrete water main, Mansfield, Ohio. Engineers: Shaffer, Parrett and Associates.

MANSFIELD . . . Pratt Butterfly Valves meet all specs for distribution service

The real test of a distribution valve is its ability to operate when needed. Valves in water distribution service are primarily emergency measures, normally left either open or closed for months, or even years. Yet, they must operate when needed, often to prevent serious property damage in the event of a broken water main.

Mansfield engineers chose Pratt High Pressure Rubber Seat Butterfly Valves for this rigorous duty because Pratt valves meet all specifications for distribution service. The critical disc edge is a corrosion-resistant material, seating against a heavy, mechanically retained rubber liner to provide *permanent, drop-tight shutoff.* The stainless steel valve shaft rotates in bronze bearings, self-lubricated for life, and the valve operator is permanently lubricated and sealed. These features are your assurance of easy operation when you need it . . . features that are built into Pratt valves with the experience that comes with 30 years of leadership in butterfly valve design. Specifying Pratt valves puts this experience to work for you.

NEW! Latest, most accurate pressure drop and flow data, conversion tables, discussion of butterfly valve theory and application plus other technical information . . . **Manual B-2B.**



HENRY PRATT

RUBBER SEAT **Butterfly Valves**

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

Briefs

Split Flow Treatment solved a problem of iron and manganese removal in the water softening plant at Eau Claire, Wis. In this case, ground water from certain wells contained iron and manganese—other wells did not. By proper mixing and split flow treatment of these two sources of supply and the use of an upflow softener clarifier, satisfactory results were obtained—page 311.

Aluminum Covered Reservoir provided an economical solution to the problem of evaporation and helped relieve a critical water shortage at Las Vegas, Nev.—page 317.

Water Purification, distribution and resources were discussed at the AWWA meeting in Dallas. In this concluding report on that meeting, the papers presented in those divisions are reviewed—page 319.

MPN Coliform Index as a yardstick of pollution has several limitations when the dilution technique is used. For this reason the MPN determination by dilution method should not be treated with sacred reverence. Application of the MF Technique offers a means to reduce the elements of uncertainty in the MPN Coliform Index—page 334.

Algae Effects on D.O. and B.O.D. as studied by the Wisconsin Committee on Water Pollution were reported in two parts in June and July. In this Part III the subject is discussed by a different author, with respect to USPHS studies—page 339.

Chlorine Valve, hydraulically operated can be made from a simple redesign of a Mueller pressure valve—page 342.

Turnpike Service Areas in the new highway systems need sewage treatment; for these areas the trickling filter has been found to be advantageous. Predigestion of sludge has also been used—page 343.

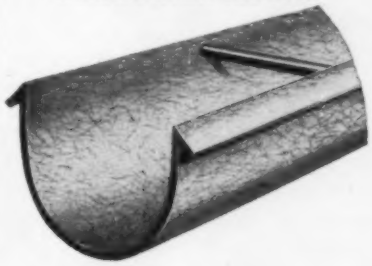
Asphalt Paved Sludge Beds have been used successfully in Salt Lake City; their construction is described—page 347.

Tributes to Linn H. Enslow have been received from many of his friends and have been collected for publication here—page 349.

The Annual Reference Number of *Water & Sewage Works* will be published this month. As heretofore, this issue will carry a consolidated five-year index to subject matter and authors (1958 and four previous issues). This five-year index is included because many of the reference articles in the previous four years have not become out of date. Therfeore, for a complete reference library subscribers should keep the current and past four issues.—All subscribers receive this annual Reference Number. New subscribers after August will receive the Reference Number as a premium.

Leopold

FIBERGLASS-REINFORCED PLASTIC WASH TROUGHS



- Eliminate the costly maintenance jobs of chipping and painting!
- Easy to handle—inexpensive to install!
- Weather-resistant—will last indefinitely!

With a background of more than 30 years' experience in wash trough design, Leopold has now developed a trough of Fiberglass-Reinforced Polyester-Laminate Plastic—a material that is structurally ideal for wash water troughs.

This new design offers a combination of advantages provided by no other type—uniform strength, dimensional stability, light weight for easy handling, complete resistance to weather and corrosion, built-in sand stop, mold-formed weir edges, and reinforced construction. In addition, Leopold Plastic Troughs, made from extra heavy fiberglass mat, are very durable—will last for years without any painting or other maintenance.

And of particular note—these unique troughs are available in a variety of cross-sectional dimensions, providing capacities to suit individual requirements.

Mail Coupon for Literature —Complete Details

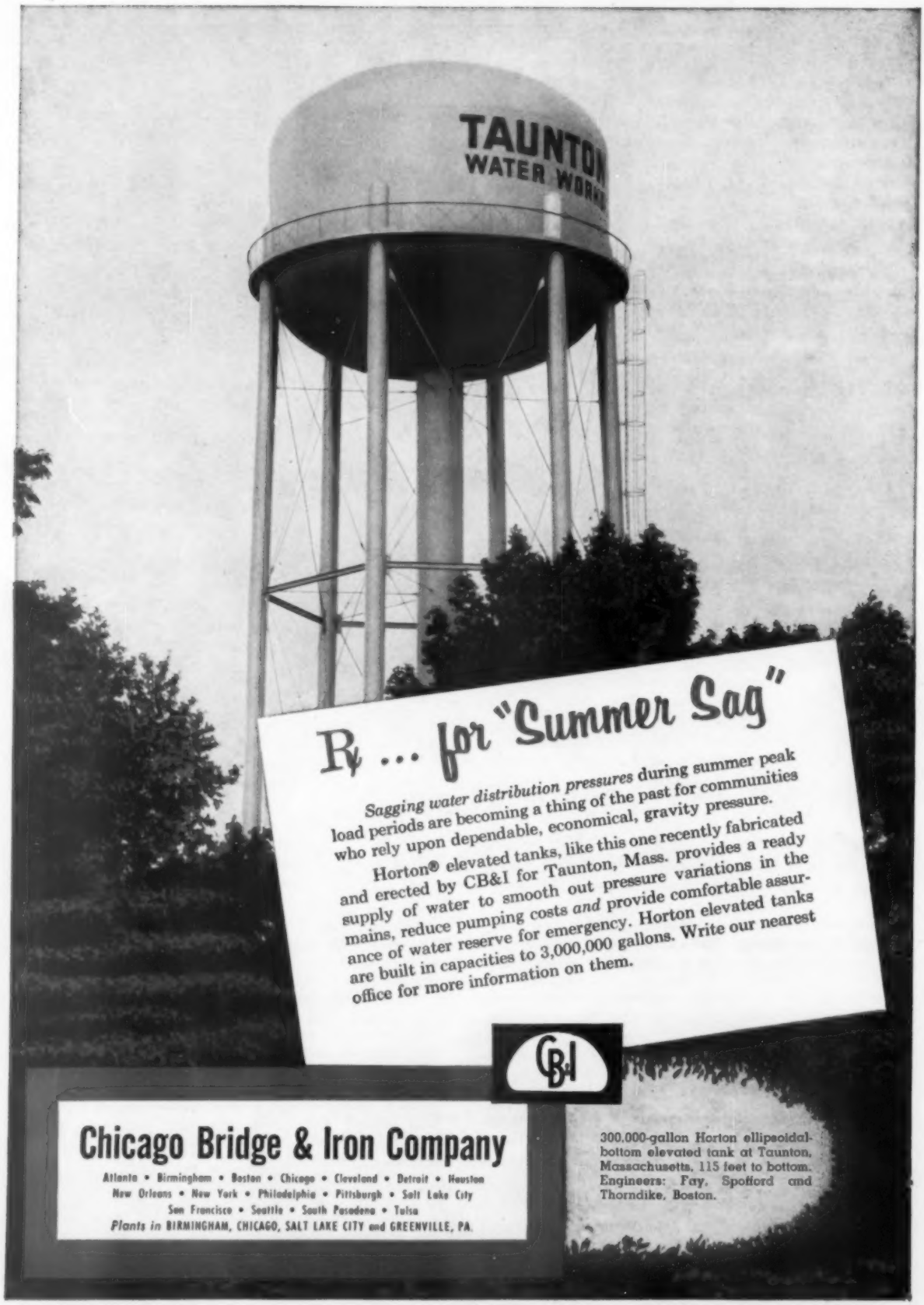
F. B. Leopold Co., Inc.
Zelienople, Pa.

Please send literature on Leopold Fiberglass-Reinforced Plastic Wash Troughs.

Name_____

Address_____

City_____ Zone____ State____



Rx ... for "Summer Sag"

Sagging water distribution pressures during summer peak load periods are becoming a thing of the past for communities who rely upon dependable, economical, gravity pressure.

Horton® elevated tanks, like this one recently fabricated and erected by CB&I for Taunton, Mass. provides a ready supply of water to smooth out pressure variations in the mains, reduce pumping costs *and* provide comfortable assurance of water reserve for emergency. Horton elevated tanks are built in capacities to 3,000,000 gallons. Write our nearest office for more information on them.

CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

300,000-gallon Horton ellipsoidal-bottom elevated tank at Taunton, Massachusetts, 115 feet to bottom. Engineers: Fay, Spofford and Thorndike, Boston.

News—Here & There

Earl Devendorf

of Schenectady, Director of the Bureau of Environmental Sanitation for the State Health Department, has been awarded the Hermann M. Biggs Award of the New York State Public Health Association for outstanding work in the field of public health.

The award is named in honor of a pioneer in public health and former State Health Commissioner. Among the previous award winners are Dr. Edward S. Godfrey, Jr., former State Health Commissioner; and the late Dr. Augustus B. Wadsworth, former director of the Division of Laboratories and Research of the State Health Department.

Mr. Devendorf, who has been with the State Health Department for more than 40 years, was graduated from Union College, Schenectady, in 1912, and received his master's degree in civil engineering in 1916. He joined the Department in 1918 as an assistant sanitary engineer. He was appointed assistant director of sanitary engineers in 1928, and named to his present position in 1948.

He is a member and former chairman of ORSANCO, and a member of INCODEL. In 1943, he was awarded the John M. Diven Medal of the American Water Works Association for conspicuous service, and the George Warren Fuller Memorial in recognition of outstanding service to the water works profession. Last year he was awarded the Arthur S. Bedell Medal of the Federation of Sewage and Industrial Wastes Assn.

Penn State University

will hold a Sewage Works Course on the Penn State campus on Sept. 15 through 19. The course is jointly sponsored by the University and the Penna. State Health Dept. Two courses will be offered: a basic course for personnel new to the field or persons who wish to review fundamentals and an advanced course on "Operation and Maintenance of Primary Treatment Plants." In the summer of 1959, a basic course and an advanced course on trickling filter plants will be given. In 1960, during the summer the advanced course will cover activated sludge plants. Enrollment is through the Extension Conference Center, Penna. State Univ., University Park, Penna.

Prof. Harold E. Babbitt

has been appointed as Visiting Professor of Sanitary Engineering for 1958 at the University of Missouri, College of Engineering in Columbia, Mo. Prof. Babbitt, whose books on water and sewage treatment are widely used, retired a few years ago after a long tenure as head of the department of sanitary engineering at the University of Illinois. He has since been in Seattle and in South America.

The University has also announced the appointment of Col. Walker W. Milner, U. S. Army Corps of Engineers, as Assoc. Prof. of Civil Engineering.

NEWWA Officers

nominated for the year beginning at the annual meeting in September are:

President: Clarence L. Ahlgren, Asst. Supt., Water Works, Manchester, N. H.

Vice President: Kenneth W. Robie, Supt., Water Dept., Brookline, Mass.

Director: Kenneth F. Knowlton, Supt. and Chemist, Salem and Beverly Water Supply Board, Beverly, Mass.

Treasurer: William P. Melley, Commissioner, Water Dept., Milton, Mass.

The annual meeting this year will be held on Sept. 14-17, 1958 at Poland Spring, Me.

Thomas P. Browne II

Export Manager of the Permutit Co., a division of Pfaudler-Permutit, Inc., was chosen President of the Association Interamericana de Ingenieria Sanitaria (Inter-American Association of Sanitary Engineers), familiarly known as AIDIS, at its sixth congress in San Juan, Puerto Rico, on May 18th to 24th.

From 1946 to 1954, he served successfully as Chairman, Finance Committee, Secretary U.S.A. Section, President U.S.A. Section and U.S.A. member Board of Directors of AIDIS, and in 1954, was given the Hemispheric Sanitary Engineering Award.

After graduating from New York University with a Ch. E. Degree, Browne joined the Permutit Company in 1928. In 1941 to 1946, he was on active duty with the U.S. Army Corps of Engineers.

The University of Florida

wants applications for two qualified "Research assistants in Sanitary Chemistry leading to M.S. and Ph.D. degrees beginning with the fall semester of 1958." Students selected will work on a Public Health Service research grant project involving basic studies in water coagulation. Interested students should contact Dr. A. P. Black, Research Professor of Chemistry, University of Florida, Gainesville, Florida.

Long Island Water Conference

has elected the following officers for the ensuing year. Chairman—Robert M. Grieve, V.P. & Supt., Citizens Water Supply Co. 1st Vice Pres.—Wm. A. Cisler, Commissioner, Hicksville Water Dist. 2nd Vice Pres.—John C. Trask, Supt., Plainview Water Dist. Secretary—Sam C. McLendon, Partner, H. G. Holzmacher & Assoc. Treasurer — Howard T. Maurer, Commissioner, Albertson Water Dist.

US RUBBER

USCOLITE PLASTIC PIPE

Laying 6" Uscolite pipe in Pine Ridge Golf Course. Despite its size, this 40' length is easily handled by three men.

Note the flexibility and easy handling of Uscolite pipe, being placed in a 3-ft. ditch.

Mr. Usco says:

The grass is always greener with Uscolite Pipe

Joining Uscolite pipe with UscoWeld* solvent-weld fittings. Each joint takes about 90 seconds to make up and is locked for life.

Take a look at Baltimore's lush new 6600-yard municipal golf course, Pine Ridge. Its beautiful greenery is nourished by a special watering system which flows through Uscolite® plastic pipe. Over 19,000 feet of Uscolite pipe (in sizes from ¾" to 6" i.d.) spread into an underground network running to tees, greens, clubhouse and certain fairway locations.

Cost-conscious Baltimore officials selected Uscolite because:

– Its smoother finish offers less friction-resistance than metal, hence, a smaller i.d. (and less expensive) pipe is used.

– Uscolite's light weight makes it easier and quicker to install with less manpower; installation costs cut in half.

– Pipe's flexibility means it can be curved without fittings.

– Solvent-weld fittings cut assembly time in half.

– Uscolite has high impact resistance and is absolutely impervious to corrosion by soil or water; scale will not accumulate and reduce flow.

Uscolite—the complete line of plastic pipe in America—carries the National Sanitation Foundation Seal of Approval.

• • •

When you think of plastic, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality plastic pipe and fittings.

*Patent applied for

US RUBBER

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

News—Here & There (continued)

John K. Hoskins

former Asst. Surgeon General and Chief of the Sanitary Engineering Division of the Public Health Service, died in mid-May at his home in Maryland.

Mr. Hoskins joined the Public Health Service in 1913, became a member of the Commissioned Corps in 1930, and capped a distinguished career in sanitary engineering science with his appointment ment as first chief sanitary engineer for the Service, when that post was created in 1943. He served in that position until his retirement in 1948.

As chief of an outstanding group of engineer-scientists stationed in Cincinnati, Mr. Hoskins worked on the stream pollution investigations of the Ohio River in the early decades of the century. This work provided the basis for much of the present knowledge of water pollution control.

Mr. Hoskins was 74 years old. He received a B.S.C.E. from Pennsylvania State College in 1905, and then went to Europe where he matriculated at the University of Berlin. He was a member of the APHS, AAAS, AWWA, FSIWA, of which he was past president.

The Paterson Engineering Co.

which markets the Tarrant hydraulic slide rule for sanitary engineers has moved its offices to 129 Kingsbury, London, W. C. 2, England.

Fifteen Years Ago

this month, a news item in this magagine reported that the Fuller Award Society of AWWA had been organized at the Cleveland meeting of AWWA. First president was Wendell R. LaDue, Supt. and Chief Engr. of Water & Sewage at Akron, Ohio. Both the Society and Mr. LaDue are still going strong.

W&SWMA

member companies which have reserved exhibit space for the forthcoming convention of the New England Water Works Association to be held at the Poland Spring House, Poland Spring, Maine, September 14-17, 1958.

American City Magazine
Badger Meter Mfg. Co.
B-I-F Industries, Inc.
Centriline Corp.
Chicago Bridge & Iron Co.
Dresser Manufacturing Div., Dresser Industries, Inc.
Fischer & Porter Co.
Gamon Meter Div., Worthington Corp.
Hersey Manufacturing Co.
Hilco Supply, Inc.
Homelite
Johns-Manville
Keasbey & Mattison Co.
Lock Joint Pipe Co.
Ludlow Valve Manufacturing Co. Inc.
Mueller Co.
Neptune Meter Co.
Red Hed Mfg. Co.
Rockwell Manufacturing Co.
Shahmoon Industries, Inc.
Warren Foundry & Pipe Div.
Smith Mfg. Co., A. P.
Smith-Blair, Inc.
S. Morgan Smith Co.
U. S. Pipe & Foundry Co.
Eddy Valve Co.
Water & Sewage Works
Water Works Engineering
R. D. Wood Co.

William L. Havens

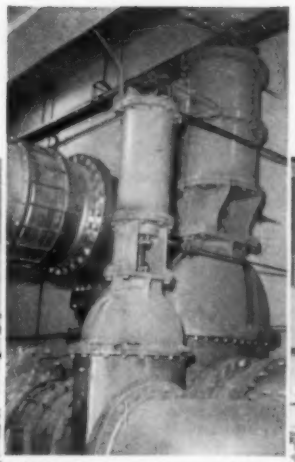
Senior Partner in the Consulting Engineering Firm of Havens & Emerson in Cleveland died in late April. A graduate of Cornell University, he worked in the Cleveland Bureau of Sewage Disposal from 1916 to 1922 when he joined the staff of George B. Gascoigne and Associates, Consulting Engineers. Upon Mr. Gascoigne's death in 1940, Mr. Havens and the late Charles Emerson formed the present firm.

Mr. Havens was the author of many articles and was a member of ASCE, NSPE, AWWA, APWA, FSIWA, AICE and Tau Beta Pi.

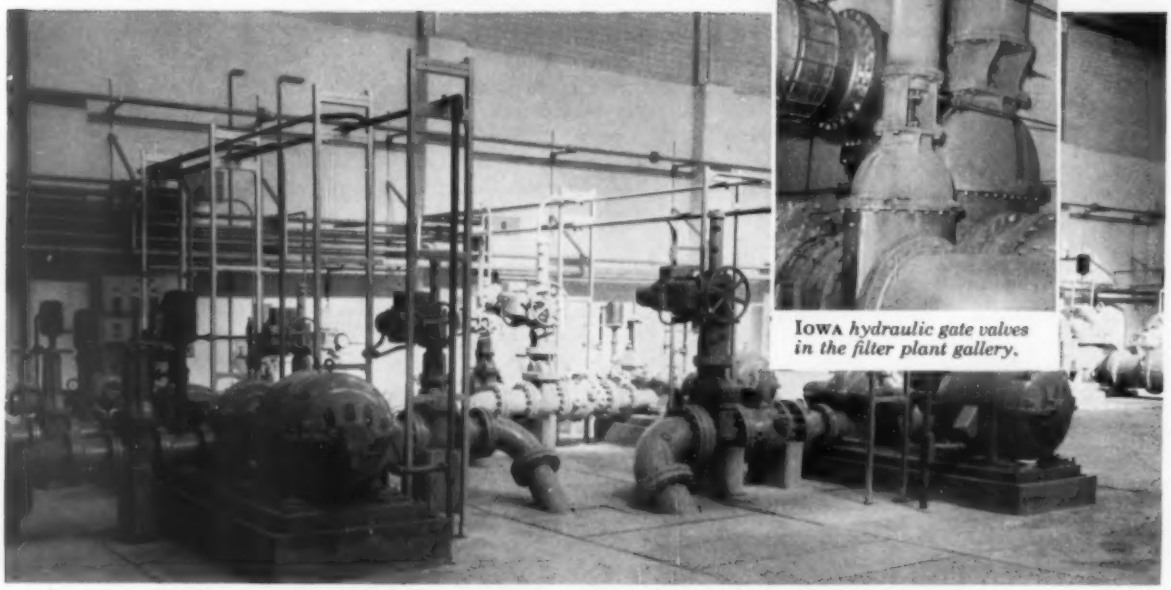
Twelve Florida Operators

were cited for outstanding water and sewage plant operation by the State Board of Health at the University of Florida. Shown here they are (seated, from left to right) Harry L. Berkstresser, director of public utilities, Panama City; David B. Lee, director, Bureau of Sanitary Engineering, State Board of Health, Jacksonville, who presented the awards; Leon C. Jackson, Cosme Water Plant, St. Petersburg; Edward T. Helms, water plant superintendent, Winter Haven; (standing, left to right) Kenneth E. Drautz, chief chemist, City of Miami sewage plant; Cliff Courson, Tampa Sewage Plant; J. L. Burnett, Tampa Water Plant; Perry A. Cessna, superintendent, Water & Sewage Plant, Bradenton; Richard L. Priester, St. Augustine Water Plant; and William H. Case, superintendent, Winter Haven Sewage Plant. The awards are in several classes for: best operated sewage treatment plant, any class; best lime softening water plant; best operated primary treatment water plant; best activated sludge sewage treatment plant; best operated primary sewage treatment plant; best coagulation and filtration water plant; best trickling filter sewage treatment plant; with citations in each class for different size cities.

40 IOWA GATE VALVES...



IOWA *hydraulic gate valves in the filter plant gallery.*



IOWA *motor-operated gate valves installed in the main pump station of North Texas Municipal Water District. (General Manager: Mr. A. P. Rollins; Consulting Engineers: Forrest and Cotton; Design Engineer: Mr. Ormond A. Stone.)*

Control delivery of
20 million gallons of water a day
for the North Texas Municipal Water District

• Forty IOWA Hydraulic and Motor-operated Gate Valves—from 4" to 30" sizes—are used in the Filter Gallery and High Lift Pump Station of the North Texas Municipal Water District, supplying 10 North Texas Municipalities and the District's largest customer, the City of Dallas. Additional IOWA gate valves are used in the six pumping plants operated by the district.

The Filter Plant, located at Wylie, Texas, has a capacity of 20 million gallons a day. However, the design is such that it can operate safely at twice this amount. Water is delivered to the ten member municipalities and the City of Dallas through 90 miles of transmission line, ranging from 12 to 42 inches in diameter.

This Texas application is typical of the ability of IOWA to furnish gate valves to meet the most exacting specifications for plant and distribution service. Be sure and check the wide variety of IOWA valves, accessories and specialties before you place your order.

Let us send you details on Iowa's complete line of valves and hydrants

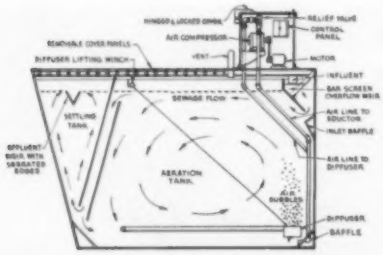
IOWA
VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.
Oskaloosa, Iowa

Equipment News

Low Cost Factory-Built Sewage Treatment Plant

801

Smith & Loveless, Inc., Kansas City, Mo., has developed a low-cost factory built sewage treatment plant, the Oxigest.

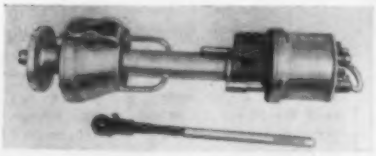


The Oxigest, approved by F.H.A. and state health departments wherever submitted, is a permanent sewage treatment plant, requiring minimum maintenance. It has been carefully engineered for dependable treatment without the necessity of a skilled operator. The shot-blasted steel structure is completely protected by Smith & Loveless Versapox coating and magnesium anodes, and is properly reinforced to withstand interior and exterior pressures. It is completely assembled at the factory, factory-tested and adjusted, and quickly and easily installed. Oxigest plants are available in five standard sizes.

Automatic Drilling Machine For Large Pipe

802

Mueller Co., Decatur, Ill., has developed an automatic drilling machine for making cuts from 2 in. through 12



in. in any type of pipe. The drilling machine, to be known as the "CL-12" Machine, is intended primarily as a water distribution cutting machine. The new drilling machine features direct-reading tool position and feed travel indicators and automatic disengagement of the tool feed.

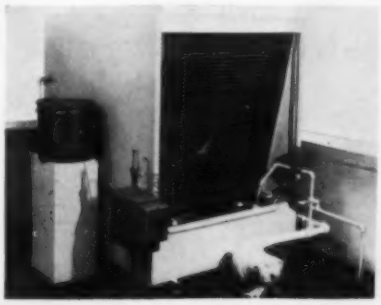
The automatic tool position indicator works full time, showing the position of the pilot drill and shell cutter in relation to their fully-retracted position. As the cut progresses, the tool position indicator adds always showing the total distance the tools have traveled. The feed travel indicator is easily set for the amount of travel required for a desired cut. As the cut progresses, the feed travel indicator subtracts showing the amount of cut or travel remaining in automatic feed. When the pre-set feed travel in automatic feed is reached, the feed is automatically disengaged and the machine idles. When not cutting, the boring bar may be rapidly advanced or retracted by hand.

The CL-12 may be operated by hand with a ratchet handle or power driven with the Mueller H-601 Air Motor or Mueller H-602 Gasoline Engine Drive Unit. No changes in the machine are required to use either hand or power operation.

Chemical Feeder and Treatment Regulator

803

Heller Laboratories, Inc., Leonia, N. J., has developed the Hydrotrol, a



new chemical feeder and automatic water treatment regulator used to control rust, scale, corrosion, slime and algae in recirculating cooling water systems for air conditioning, refrigeration and process cooling.

Many devices and methods for controlling treatment have been used in recent years in an effort to simplify and reduce the cost of control but the best of these methods required rela-

CONTINUED ON PAGE 15A

SUPER DELAVAUD

The First Name In CAST IRON PIPE

Tested from every angle to assure more long years of trouble free service.

- CHEMICAL TEST
- WALL THICKNESS TEST
- TALBOT STRIP TEST
- PIPE RING COMPRESSION TEST
- SAND COMPRESSION TEST
- ROCKWELL HARDNESS TEST
- EXTERNAL IMPACT TEST
- INTERNAL PRESSURE BURSTING TEST

FOR WATER, GAS and SEWAGE
In modern long lengths—Bell and Spigot, roll-on-mechanical joint and flanged.

For The Best Connection You'll Ever Make

Investigate The New ALTITE JOINT by APCO

Underwriters Approved
Patent Applied For.

ALABAMA PIPE COMPANY

General Offices—ANNISTON, ALABAMA

SALES OFFICES

122 South Michigan Ave. Chicago 3, Illinois
350 5th Avenue New York 1, New York
950 Dierks Building Kansas City, Missouri
18505 West Eight Mile Rd. Detroit 41, Michigan

NOW

ROILINE ENGINES (formerly LE ROI) ARE BUILT BY WAUKESHA...

8-Cylinder H-540 ROILINE Unit—to 163 hp V-12 L-4000 ROILINE Engine—to 685 hp

THESE FORMER LE ROI MODELS BECOME WAUKESHA ROILINE ENGINES

Model	Bore and Stroke	No. of Cyls.	Disp. Cu. In.	Max. Torque Lb./Ft. @ RPM	Brake Horsepower at Engine Speeds Indicated 600	800	1000	1200	1400	1600	1800	2000	2200	2400
H540	4½ x 4¼	8	540	454.... 900		68	87	105	122	138	151	164	173	178
H844	5¼ x 4½	8	844	671....1500		113	145	177	205	231	255	274	290	299
F1500	6¾ x 7	6	1503	1165.... 650	134	176	214	230						
H2000	6¾ x 7	8	2004	1590.... 650	180	240	280	300						
L3000	6¾ x 7	12	3006	2420.... 650	275	360	435	460						
L3460	7⅛ x 7	12	3468	2750.... 900	305	416	527	608	635 @ 1350 RPM					
L4000	7.54 x 7.5	12	4000	3110.... 900	345	471	595	685						

These are engine ratings on LP Gas . . . send for Power Chart with ratings for engines and complete power units operating on natural gas, LP Gas, and gasoline.

WAUKESHA MOTOR COMPANY

under famous Waukesha Quality Control

THE ADDITION of these well-known gas and gasoline engines to the Waukesha line... produced by Waukesha engine-builders and sold through the former Le Roi engine distributors... is of great importance to all users of internal combustion engine power.

The principal models of Le Roi gas and gasoline engines, formerly built by the Le Roi Division of the Westinghouse Airbrake Company, have been sold to the Waukesha Motor Company. The engines listed on the opposite page will be known as Waukesha "ROILINE" engines, and be built as bare engines, complete power units, and with components and accessories for special services.

Le Roi engines are widely used in the oil industry, and in various types of cotton ginning, compressor, generator, and pumping installations. They have been well-known in these fields and in other internal combustion engine applications for many years.

Waukesha has all rights to the manufacture and sale of these former Le Roi engine models and the service parts, patterns, and designs. Waukesha will produce the V-8 models H-540 and H-844 high speed transport and industrial engines in the Waukesha plant. The remainder of the engine models, including the in-line Six and large V-8 and V-12 engines, will be manufactured in Waukesha's Climax Division plant at Clinton, Iowa. ROILINE engines, parts, and service will be available in all sections of the country to owners, operators, and purchasers of these fine engines, through the ROILINE distributor organization. OEM accounts normally serviced directly by the manufacturer will be handled through the Waukesha headquarters sales office.

This expansion of Waukesha's production will enable Waukesha to manufacture and supply internal combustion engine power for any requirement from 6 to 1200 horsepower in all normal speed ranges and for use with all standard fuels.

• *The trade mark LE ROI is used under license from Westinghouse Airbrake Co., the trade mark owner.*

383

SEE YOUR ROILINE DISTRIBUTOR

ARIZONA
Casa Grande
Engine Service Company

ARKANSAS
Paragould
Wonder State Manufacturing Co.

CALIFORNIA
Long Beach
Engine & Equipment Company

ILLINOIS
Centralia
John Nickell Company

LOUISIANA
Shreveport
Ingersoll Corporation

OHIO
Columbus
Cantwell Machinery Company

OKLAHOMA
Chickasha
Chickasha Gin & Mill Supply
Oklahoma City
Carson Machine & Supply Co.

PENNSYLVANIA
Pittsburgh
P. C. McKenzie Company

TEXAS
Houston
Southern Engine & Pump Co.
Lubbock
Farmers Supply Company
Odessa
General Machine & Supply Co.
Wichita Falls
Nortex Engine & Equipment Co.

UTAH
Salt Lake City
Transport Equipment Center

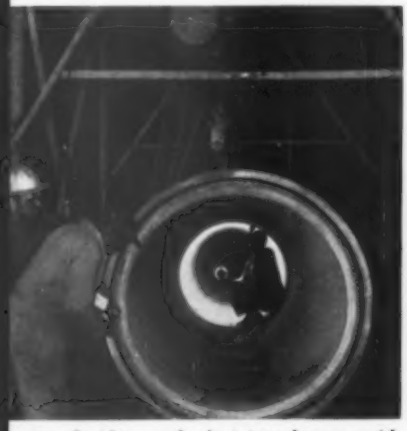
WYOMING
Casper
Emrick & Hill Engine & Equipt. Co.

Waukesha, Wisconsin • New York • Tulsa • Los Angeles

1. Straddle carrier brought this piece of pipe 1½ miles through tunnel. Will back out for next piece.

2. Lubricated rubber gasket stretched over steel gasket ring on spigot end of concrete cylinder pipe.

3. Special rig supports new section as pull-jack completes joint. Side jacks handle horizontal alignment.



4. Inside man checks joint tolerances with gauge, as outside man cleans steel joint ring at bell end.

5. Wye section hauled in flat and jacked to vertical position; will take off through tunnel wall, right.

6. Bucket on high lift chutes across installed section to pour cradle for permanent support.

Workmen use new tricks to lay concrete steel-cylinder pipe in unused Cincinnati subway

The workmen who installed Cincinnati's new 48-inch water transmission line were faced with unusual problems, as 11,000 feet of the line's 14,000-foot length were inside an unused subway tunnel. The subway was built beneath Cincinnati's Central Parkway over 30 years ago, but because of changes in the city's growth pattern, was never used.

The above pictures were taken a mile and a half from the mouth of the tunnel. A single piece of pipe was hauled through the tunnel to the installation spot, then transferred to a special rig to be raised or lowered into vertical alignment. Jacks between the pipe and tunnel walls handled horizontal alignment. A pull-jack completed the joint, and timbers were used for temporary support until permanent cradles were poured.

Standard 16-foot lengths, with beveled ends, were used on curves. These units provided deflection up to 4 degrees at the joint. Minor changes in alignment were handled by "cracking" the steel-and-rubber joint of standard-end pipe as much as one half inch.

According to Charles M. Bolton, Supt. of Water Works, concrete steel-cylinder pipe was selected for this job because it would provide high initial, and high ultimate capacity; because it could be expected to give long service with a minimum of maintenance; and because the flexible, rubber-gasket joint would handle the expansion and contraction resulting from greater temperature changes than would be experienced with a buried line.

Black and Veatch of Kansas City, consulting engineers, designed the line. Charles F. Smith and Son, Inc., of Kennett Square, Pa., were general contractors. Price Brothers Company of Dayton, Ohio and Hattiesburg, Miss., manufactured the pipe.

Price Brothers

Equipment News

CONTINUED FOM PAGE 11A

tively frequent adjustment of chemical feed and water bleed off to compensate for "drift" or wandering of treatment from desired valves.

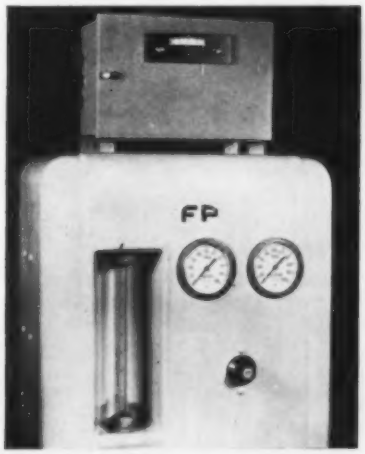
The "drift" in treatment is due to the fact that devices used heretofore did not change the rate of feeding or the rate of bleed off as the load on the cooling system or the amount of water evaporated was changing. To compensate for the resulting "drift" frequent water analyses with manual adjustments of feed and bleed off were required.

Hydrotrol is said to save 95% of the labor required for service, analysis and adjustments, an average of 50% on chemicals for air conditioning cooling applications and on water unnecessarily wasted. Precise control with Hydrotrol will assure proper treatment and consequent savings on maintenance and longer equipment life. The unit costs no more than many constant volume feeders.

New Chlorinator with Automatic Proportioning

804

Fischer & Porter Co., Hatboro, Pa., has introduced a Pneumatic Control Chlorinator which automatically proportions chlorine flow to primary flow and costs substantially less than similar units.



The new chlorinator uses a compact ratio relay which may be mounted either on the wall or on top of the chlorinator. The radio relay assembly, which serves as a dosage adjustment, receives a 3-15 psig signal to the chlorinator's pneumatic rate valve. The output signal from the ratio relay unit is maintained at an adjustable preset ratio to the input signal.

The new F&P chlorinator can be used also as the final control element in a residual chlorine control setup. Used thus, the chorinator's pneumatic rate valve is operated by a 3-15 psig signal transmitted directly from a residual chlorine analyzer located downstream from the chlorinator.

New Anion Bed Support Reduces Rinse Requirements

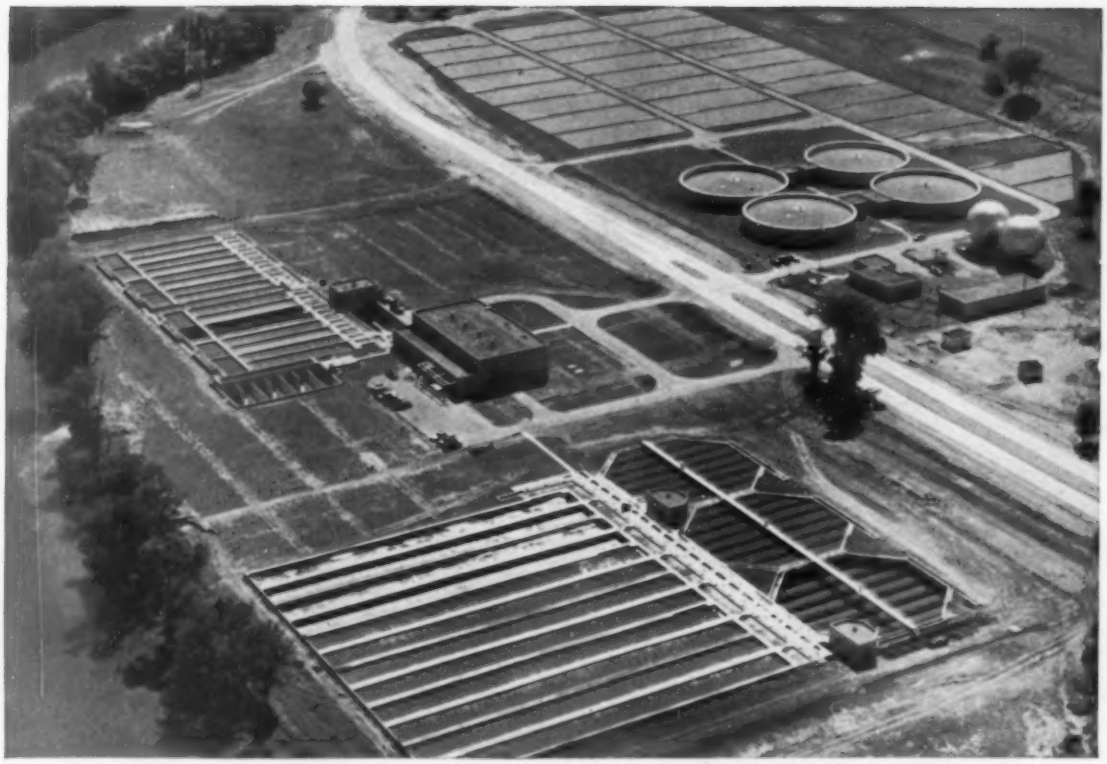
805

Graver Water Conditioning Co., New York, N. Y., has developed an anion unit bed support that eliminates the need for subfill media and substantially reduces final anion unit rinse requirements.

This design provides for the replacement of subfill media by specially

CONTINUED ON PAGE 17A

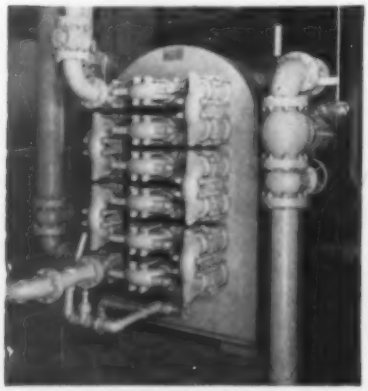
EASY TO
INSTALL CUTTING-IN
VALVES FOR BETTER
CONTROL
MH
MECHANICAL JOINT
M & H Cutting-In Valves and Cutting-In Sleeves have mechanical joints designed to work with various classes of cast iron pipe. By cutting a short section of correct length out of an existing pipe line, the Sleeve and Valve are easily installed by unskilled workmen. The Cutting-In Valve is the same design, construction and materials as M & H A.W.W.A., double disc gate valves, except for the mechanical joint and connections designed to work with various outside diameters of different classes of pipe. These valves are available with O-Ring seal or conventional stuffing box. Sizes, 4" through 12". Write or phone for details.
M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF
WALWORTH



South Bend Sewage Treatment Plant located on the St. Joseph River. The four PFT Floating Covers can be seen in the background. Consoer, Townsend and Associates, Chicago, Consulting Engineers.

South Bend restores beauty and recreational facilities to the St. Joseph River

This new South Bend Sewage Treatment Plant has solved a long-time health hazard for South Bend and all the communities to the north on the St. Joseph River. The river is now being restored to its natural cleanliness and beauty.



Special PFT-Drum Type Heat Exchanger Units

PFT equipment plays a big part in this sewage treatment and reclamation project. Each of the four 110′ digesters is equipped with PFT Floating Covers. Heat for the digesters is supplied by the two No. 750 Heaters and Heat Exchangers and two PFT No. 429-E Special Drum Type Heat Exchanger Units.

These Special Drum Type Heat Exchanger Units (shown at the left) are so arranged that the Jacket Water heat is transferred to the digesters and excess heat may also be dissipated to effluent circulated through the drum shell. The South Bend Plant also makes use of the PFT-Kraus Process for Activated Sludge Control.

Waste Treatment Equipment
Exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

Equipment News

CONTINUED FROM PAGE 15A

designed anion unit lower internals. These lower internals, similar to those used in mixed-bed demineralizers, incorporate a unique corrosion resistant bed support medium which allows the passage of water in either direction while retaining the resin. The bed support also provides for uniform collection and distribution over the entire cross sectional area of the unit.

Operational results of units with the Graver underdrain design run in parallel with units having conventional bed supports have established the advantages and dependability of this system in minimizing rinse requirements.

Separan Flocculant Improved

806

Dow Chemical Co., Midland, Mich., has announced production of an improved polyacrylamide-type flocculant known as Separan NP10. A refinement of Separan 2610, its operational characteristics remain unchanged.

All Separan 2610 production has been converted to Separan NP10.

Included among product improvements are higher purity, increased solution clarity and greater product uniformity. The new material is now available in commercial quantities.

Separan NP10 is used as a flocculant in filtering, thickening and clarification processes in the mining, pulp and paper, chemical processing, water treatment and miscellaneous other industries.

High Capacity Fulflo Filter

807

Commercial Filters Corp., Melrose, Mass., has announced that a new high capacity steel Fulflo Filter is available in a full range of sizes, with from 24 to 270 10-inch Honeycomb Filter Tubes. It provides continuous microclarity for all industrial fluids at flow rates as high as 1350 gpm, with low pressure drop. A new swing-bolt cover permits easy access to filter tubes. Optional cover-lifting davit further simplifies servicing.

Standard models are for operating pressures up to 150 psi instead of the

CONTINUED ON PAGE 19A

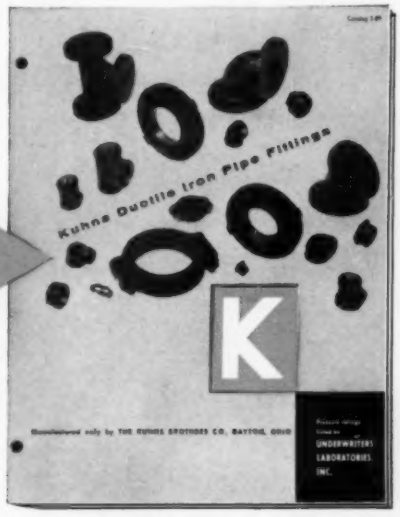
WHAT DO YOU WANT TO KNOW ABOUT KUHNS

DUCTILE IRON

PIPE FITTINGS?

THE ANSWERS ARE HERE

YOURS FOR THE ASKING!



Get complete data on—

- Types and sizes available
- Typical applications
- Safety factors and service ratings by Underwriters' Laboratories, Inc.
- Prices
- Physical properties; production control tests
- Specifications—A.M.S., A.S.T.M., Ordnance, Navy, Coast Guard, National Fire Protection Association, National Board of Fire Underwriters, Corps of Engineers
- Impact test data

DUCTILE IRON PIPE FITTINGS MANUFACTURED ONLY BY

THE KUHNS BROS. CO.
DAYTON, OHIO

THE KUHNS BROTHERS CO.
1800 McCall Street, Dayton, Ohio

Send me a free copy of Catalog 2-PF on ductile fittings.

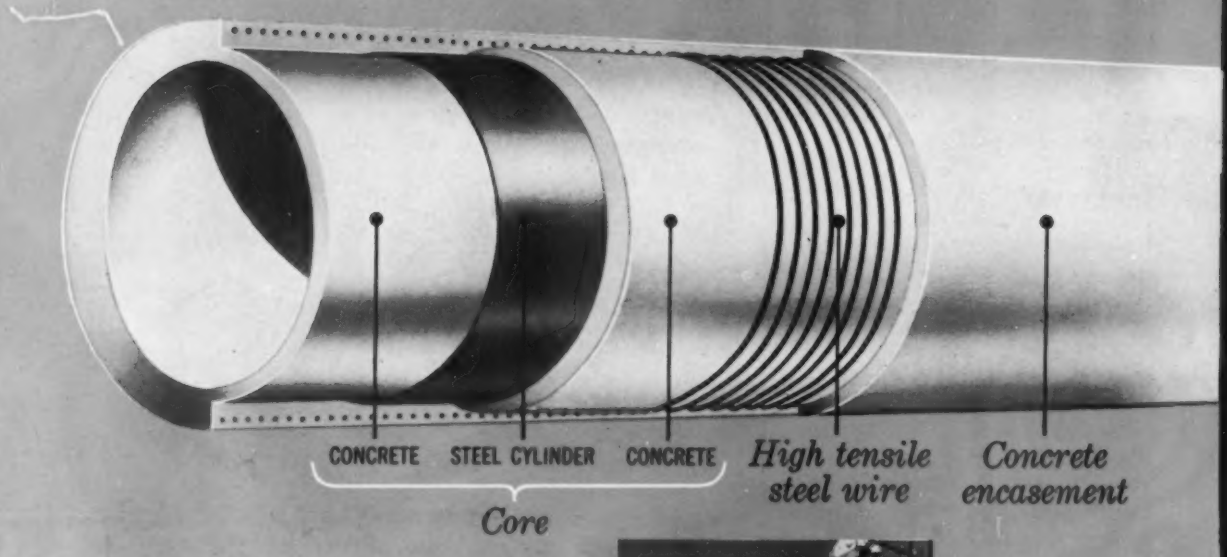
NAME_____ TITLE_____

COMPANY_____

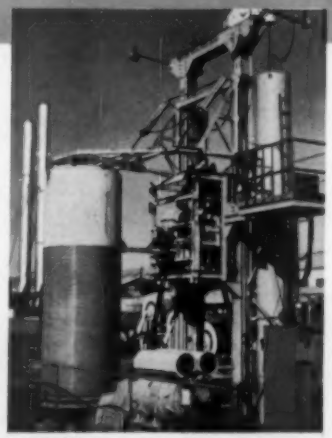
ADDRESS_____

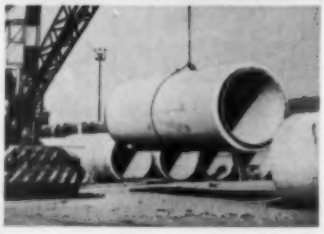
PRESTRESSED
CONCRETE CYLINDER PIPE
(Embedded Cylinder Type)

with Rubber Gasket Joint



All of the good qualities and characteristics desired by water works engineers for permanent water supply and transmission lines are embodied in this prestressed pipe of advanced design: great strength, sustained high carrying capacity, trouble-free service, and unusually long life. Prestressed pipe of this type can be designed more accurately, predictably and economically for most all conditions of internal pressure and external loads than any other type of high quality concrete pressure pipe. It is the finest quality pipe available in medium and large diameters for pressures generally ranging from 100 psi upward. American is currently undertaking the manufacture of this pipe designed for pressures ranging from 275 to 550 ft. of head for a portion of the U.S. Bureau of Reclamation Project being constructed for the Ventura River Municipal Water District. This Ventura River Project will serve 32 square miles of mountainous country with water for irrigation, municipal and industrial use in main and coastal reaches of Ventura County, California. When planning *your* future water "growth lines," look to American's quality pipe line products, extensive production facilities and half century of experience.





Prestressing machine wraps high tensile steel wire under carefully measured tension around pipe core.

American PIPE AND CONSTRUCTION CO.

LOS ANGELES: 4635 Firestone Blvd., South Gate, Calif. LOrain 4-2511
HAYWARD: P.O. Box 630—JEfferson 7-2072
SAN DIEGO: P.O. Box 13—CYpress 6-6166
PHOENIX: 2025 South 7th St.—ALpine 2-1413
PORTLAND: 518 N. E. Columbia Blvd.—BUtler 5-2531

CONCRETE PIPE FOR MAIN WATER SUPPLY LINES, STORM AND SANITARY SEWERS, SUBAQUEOUS LINES

Equipment News

CONTINUED FROM PAGE 17A

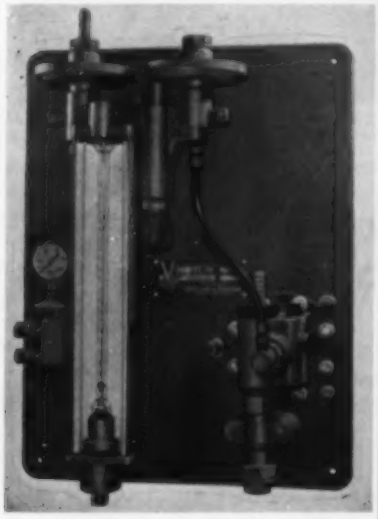
normal 100 psi. Straight line pipe connections are for 2, 3, 4 or 6-inch pipe sizes, according to capacity. Inlet and outlet pressure gauges are available to record pressure drop and indicate when filter elements should be changed.

Honeycomb Filter Tubes are manufactured in a wide range of precision controlled densities to provide the exact degree of micro-clarity needed for each operation. Tubes are available in cotton, nylon, orlon, dacron, dynal, acetate or glass fibres.

V-Notch Chlorinator Requires No Make-Up Water Or Drain

808

Wallace & Tiernan, Inc., Belleville, N. J., has developed a new V-notch Chlorinator for low-capacity installations.



The new chlorinator is wall-panel mounted—requires no floor space. No auxiliary water or drains are required, a V-Notch Variable-Orifice gives precise and smooth feed-rate adjustment, and all parts are made of corrosion-resistant plastic, molded for interchangeability.

Vacuum operation gives protection against chlorine leaks. The addition of simple auxiliary apparatus, which

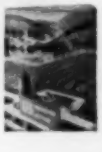
CONTINUED ON PAGE 21A

getting the MOST out of the thrust bearing in U.S. VERTICLOSED motors

U.S. VERTICLOSED MOTORS are *built around* the thrust bearing that carries all the weight of water, shaft, and pump. The U.S. formula can't be excelled: First, start with the right type of bearing having a high contact angle and bronze retainer; second, provide a large oil reservoir with a *Visolube* window to let you *see* lubricant level; third, sleeve-mount the bearing for easy removal and inspection; fourth, design ventilation so that cool air constantly flows over the bearing; and fifth, balance the motor parts before and after assembly for smoothest operation. Thus U.S. VERTICLOSED Pump Motors are made to *give you the most* performance and dependability. Available in RATINGS 1½ TO 500 H.P. In any pump installation, be sure to specify: "U.S. VERTICLOSED MOTORS."

U.S. ELECTRICAL MOTORS INC.

P. O. BOX 2058, LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT



FREE COLOR BROCHURE
...for full information, send for FREE illustrated Verticlosed Bulletin.

Installation of these two 5'-high SMS Bascule Gates on a dam 28' in height will enable the City of Decatur, Illinois, to more than double its present water storage capacity, even in dry years. The training wall and concrete pier between the gates is designed to minimize downstream cross-flow and damage to the apron. Harza Engineering Co., Chicago, Illinois, Consulting Engineers.

Individual 29'-long sections of the gate are installed in graphited bronze bearing shoes. A Bascule Gate was chosen over other types here when engineering studies proved it most economical and simplest.

View from downstream side shows final connection of one of the several hydraulic operating cylinders for each gate. Piping on the face of the dam immediately below provides individual isolation of any cylinder.

One of the two 500 psi oil accumulator tanks is about to be raised into position at the control station. Pumps supply pressure to the accumulator tanks for emergency operation in the event of power failure.

New SMS Bascule Gate Design Provides a CLEAR CREST, UNLIMITED LENGTH

Now SMS Bascule Gates can be built to any length you need, and installed without intermediate piers or overhead structures. With this new SMS design, hydraulic operators are located under the gate leaves and controlled from either end. The installation shown above consists of two 233'9" gates. They are the longest ever installed.

An SMS Bascule Gate will increase the storage and spillway capacity of existing dams quickly and economically. It enables you to control heavy run-offs without losing stored water, and to handle regional hazards like ice and heavy debris. In its open position, the gate lies flat on the dam crest and presents no obstruction to flow.

For full information on this new SMS Bascule Gate design—or on hydraulic turbines and other accessories—write to S. Morgan Smith Co., York, Penna.

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

HYDRAULIC TURBINES
PUMPS
GATES & HOISTS
TRASH RAKES
LIQUID HEATERS
HYDRODYNAMICS
ROTOVALVES
BALL VALVES
BUTTERFLY VALVES
FREE DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

Equipment News

CONTINUED FROM PAGE 19A

interrupts the water supply, provides semi-automatic operation of this economical chlorinator.

Submersible Pumps 809

Besler Corp., Dorward Pump Div., Emeryville, Calif., has introduced a complete line of submersible pumps.

Sizes from one-third horsepower through fifteen horsepower are now in production and available for immediate shipment.

This firm in one year's period has added a high speed line of turbine pumps, a line of contractors pumps, swimming pool and utility pumps to their complete line of ejector pumps. The addition of submersibles will provide a line of pumps to fit practically all applications.

Conversion Unit for Hand Operated Valves 810

C. H. Wheeler Mfg. Co., Philadelphia, Pa., has developed a low-cost conversion unit for converting valves from hand-operation to electric motor operation. This unit can be installed without special engineering, disturbing piping or replacing existing valves. Operating with complete safety, the Valvmatic, is a push-botton-operated valve actuating conversion unit.

Normal installation consists of six easy steps which plant labor can perform with ordinary tools. Valvmatic can be used in nearly every application where the valve handle doesn't rise, and where the valve handle can rotate when the valve is operating under power. In the event of power failure, the valve can be restored to manual operation by removing two pins.

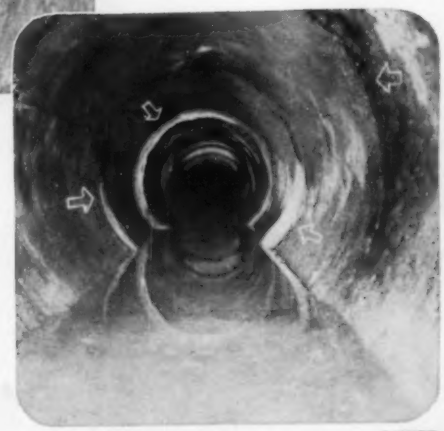
Position and torque limits are provided in both directions of rotation to prevent valve injury. Valvmatic can be moved from one valve to another, and no special wiring is needed. It is not necessary to remove the valve from the line to install the unit, nor is machining of special valve nuts involved.

Costly waste, 20 gallons of water per minute

BEFORE

STOPPED with WATERPLUG Hydraulic Cement

Waterplug stops running water INSTANTLY!



AFTER

Here is what Underwater Services, Valley Station, Ky., had to say about Waterplug

On October 6, 1957, our Underwater Services Company was called upon to repair a major break in an underwater drainage system for the Hardin County Sportsmen's Lake at Elizabethtown, Kentucky. Upon diving to the bottom of the lake we discovered several large ruptures in the 24" tiles used in the drainage system. Water, uncontrolled, was pouring through these breaks at a minimum approximate rate of 20 gallons per minute. Using underwater diving equipment we managed to reduce this torrent by packing sandbags into the holes channeled through the four feet of earth covering these tiles. Descending through a water control tower, we gained access to the interior of the drainage tiles to the area of break-through. Above us were four feet of lake bottom and 20 feet of water above that. Under these extremely adverse conditions we used the Thoro System WATERPLUG Cement to repair the breaks from the interior of the tiles.

Because of the simplicity and ease of mixing and applying WATERPLUG Cement, we were able to completely and effectively repair these breaks in the drainage system.

We were delighted with the effectiveness of WATERPLUG Cement in successfully overcoming this difficult water repair problem. Feel confident that in future underwater repair problems, our company will rely upon WATERPLUG Cement.

"How to do it" GET OUR 16 PAGE BROCHURE

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNA. CENTERVILLE, IND.

New Bulletins *AVAILABLE FREE*

Circular Slide Rule

811

General Industrial Co., Chicago, Ill., has just introduced a handy circular Slide Rule for engineers and for other plant and office executives. Any executive who must perform simple calculations will find this convenient, pocket-size calculator extremely useful in his work.

Operation of the rule is simple and the results are accurate. To multiply, divide and find proportions is easy and exceptionally fast with this convenient circular rule. Complete easy-to-follow instructions will be included with each slide rule.

Bellows Flow Meter

812

Minneapolis - Honeywell Regulator Co., Industrial Div., Philadelphia, Pa., has just published a specification sheet that describes in detail the construction and operation of the Honeywell Bellows Meter for flow and liquid level applications. Included are features, specifications, and options.

Instant Antifoams

813

Hodag Chemical Corp., Chicago, Ill., has available a 3-page information sheet and free samples of new Hodag Instant Antifoams. Hodag Instant Antifoams are available in many different formulations to suit specific requirements. Hodag formulates and produces antifoams and other surface-active chemicals for a wide variety of industries.

The information sheet includes features of the new antifoams, when and how to use them, what quantities to use, and general theory behind their use. The new Hodag Instant Antifoams come in concentrated liquid, flake or powder form. They are used as received or added to water forming a stable, stock emulsion. Eliminating the diluent saves the user in both the purchase price and freight charges.

Separators and Thickeners

814

Chain Belt Co., Milwaukee, Wis., has just published a bulletin on the Rex Foat-Treat Separators and Thickeners.

According to the bulletin the Rex Float-Treat System is a process in which suspended organic matter and chemical flocs are removed from process water by flotation. It has wide application in industry for recovering petroleum products; grease; fats; fibers; animal hair; flocculent solids; etc. It also has application in sewage plants to remove settleable solids; to provide overload relief to existing facilities; to provide greater solid concentration in sludges.

Photos and diagrams are used extensively in the bulletin to illustrate the design features; the types of tanks used; and the operating principles of Float-Treat.

Flow Indicators for Direct Observation

815

Schutte and Koerting Co., Bucks County, Pa., has just released a bulletin describing the company's line of Flow Indicators for pipeline installation to give positive visual indication of flow conditions.

According to the bulletin the indicators are applicable to liquids and

CONTINUED ON PAGE 24A

...why didn't FORD think of THIS before?

Now that we have started making the new Ringstyle Valve for copper connections, we've wondered, too, why we didn't think of this simple idea sooner. Now that we have, a patent is pending.

Of course we were proud of the old arrangement. When we introduced the Ringstyle Valve in 1938 it was a brand new idea and the meter coupling nut attached to the valve was an important development in meter setting. But the old design, with its loose ring for connecting the valve to copper, had its disadvantages.

But look what we've done with this new one. We've built the beveled end right onto the valve itself and reversed the thread arrangement. Thus, the standard copper tube nut fits right on the new Ford Ringstyle Valve for an easy-to-make, leak-proof joint. The capacity is not reduced — The appearance and utility are improved.

Former Design

The men who install this new Ford Ringstyle Valve will certainly approve this change because there's no loose ring to drop into the mud or dirt in the ditch. Connecting the valve to the copper service line is simpler, easier and quicker.

Write for information and sample.

FOR BETTER WATER SERVICES

FORD

THE FORD METER BOX COMPANY, INC. Wabash, Indiana

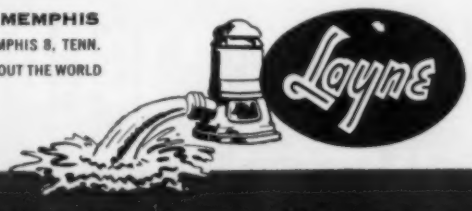
The story behind the picture....Layne Pumps

Complete municipal water systems supply water for countless needs and activities.

To any city the need for water is vital, definite and specific. Layne Pumps, designed for rigid municipal requirements, can deliver the prescribed amounts of water to any point at any given time.

That's why hundreds of cities and municipalities use and rely on Layne Pumps.

LAYNE & BOWLER, INC., **MEMPHIS**
GENERAL OFFICES AND FACTORY • MEMPHIS 8, TENN.
LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD



Water Wells • Vertical Turbine Pumps • Water Treatment

TO: Layne & Bowler, Inc.
Memphis 8, Tenn.

Gentlemen:

Please send me bulletin No. 100.

NAME _____

TITLE _____

ORGANIZATION _____

_____

ADDRESS _____

CITY _____

STATE _____

Where water is used, process equipment and storage tanks are sure to corrode unless protected by an E.R.P. cathodic protection system. Even with these concrete high rate clarifiers at the St. Regis Paper Company plant near Jacksonville, Florida, it pays to protect the metal parts with an E.R.P. cathodic system.

Engineering PLUS...
E.R.P. cathodic protection pays off in maintenance savings

In industry or public service, water treatment is a big investment. To protect that investment in water treatment equipment could be a tremendous maintenance job. Even with concrete clarifiers, it pays to use E.R.P. cathodic protection. When there are metal tanks involved, just one cleaning and painting can cost more than a complete E.R.P. cathodic protection system.

From preliminary design to continuing periodic corrosion surveys, experienced corrosion engineers measure, analyze and design specifically for your corrosion problems. That is the only way corrosion can be virtually eliminated.

E.R.P. engineering plus prevents corrosion of water storage tanks, water and sewage treatment structures and pipelines. For full information on how E.R.P. can help you save maintenance costs, write for bulletin E-46.94.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.
A SUBSIDIARY OF WALLACE & TIERNAN INC.
30 MAIN STREET, BELLEVILLE 9, NEW JERSEY
CABLE: ELECTRO, NEWARK, N. J.

W&T DRY CHEMICAL FEEDERS

For Accurate Feeding Of Water Treatment Chemicals

Full line of wide range dry chemical feeders capable of controlling a few ounces to 3000 lbs. per minute.

Write for Bulletin M-38 for complete Dry Feeder information.

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

New Bulletins

CONTINUED FROM PAGE 22A

gases—also vapors and slurries sufficiently translucent for observation of the indicating components through sight windows. A visual check is possible on flow, flow direction, and fluid condition.

Three Flow Indicator types are described in the Bulletin—flapper, rotary (paddle wheel), and ball. The latter type measures approximate flow rates. The latter type measures approximate flow rates. The flapper type is also available in construction designed to serve as a check valve. Maximum permissible pressures and temperatures run up to 250 psig and 500 F. Tempered glass is used for windows to protect against sudden temperature changes as great as 400 F. Little pressure drop is encountered with these indicators.

The Bulletin also presents information on sizes, materials of construction, minimum flows which are indicated, and pressure and temperature ratings.

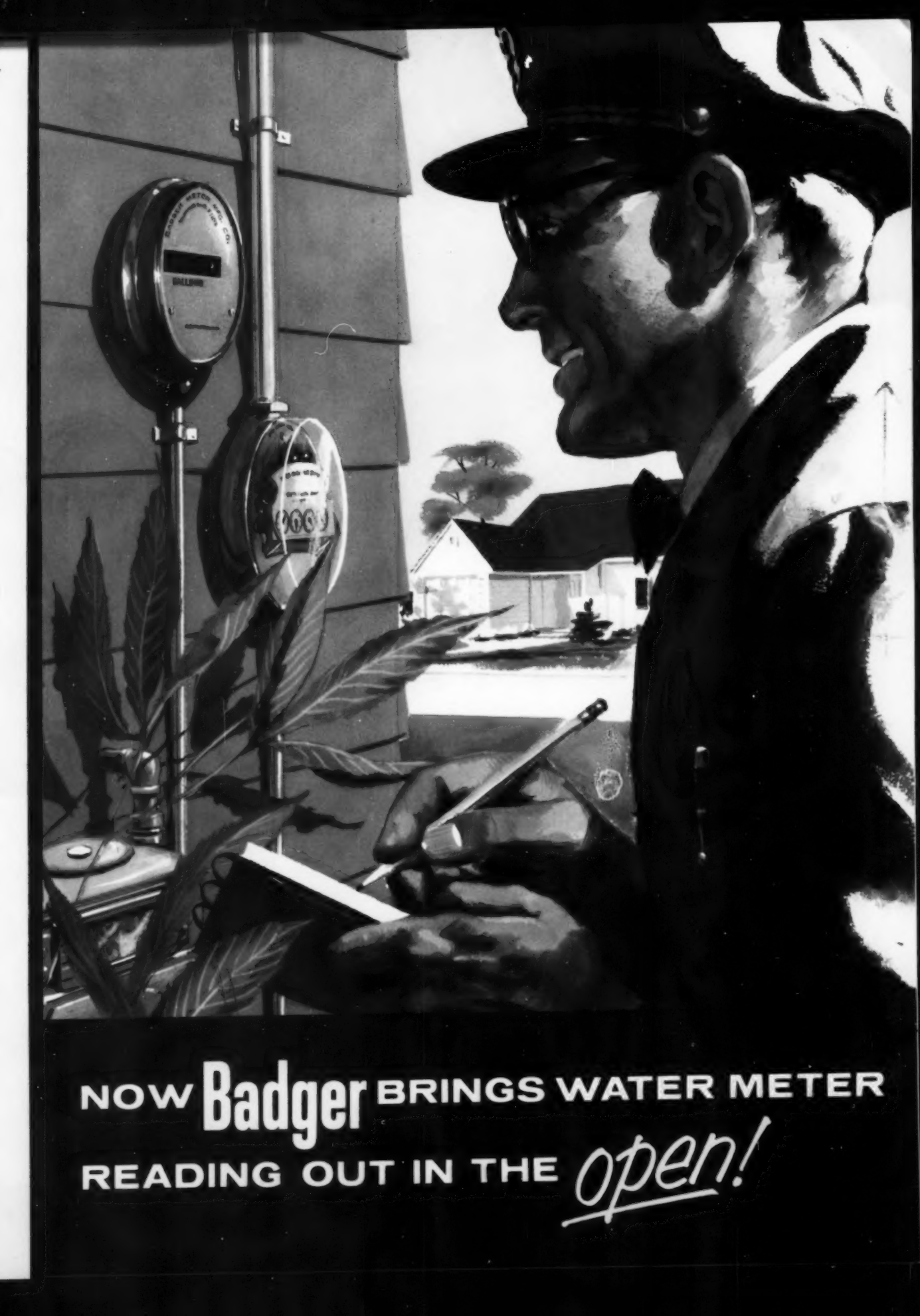
Selecting Dall Tubes, Venturi Tubes and Nozzles

B16

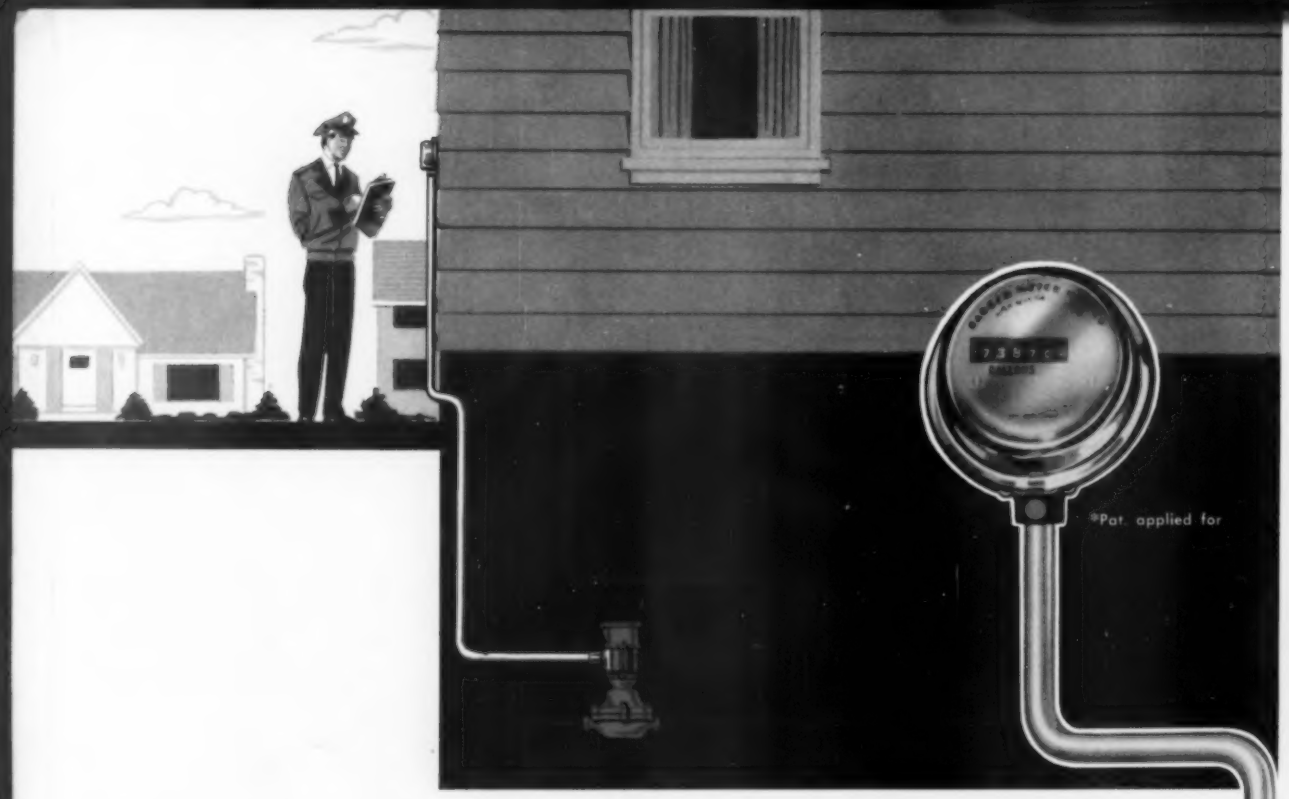
Builders-Providence, Inc., a div. of B-I-F Industries, Inc., Providence, R. I., has published a technical bulletin that users of Dall Flow Tubes, Venturi Tubes and Venturi Nozzles for the metering of all fluids will find helpful when they are faced with the problems of selecting the proper throat size and calculating the head loss in various applications. They also often need to know whether a standard throat can be used for steam, gases and liquids not covered by tabulated capacities. Simplified formulas and tables for answering these problems are given in this new bulletin.

Illustrative examples of formula application are worked out to determine such economic factors as the pumping cost per year for differential producers under typical conditions. The bulletin also contains dimensional tables, capacity tables, and performance charts.

CONTINUED ON PAGE 104A



NOW **Badger** BRINGS WATER METER
READING OUT IN THE *open!*



REVOLUTIONARY

Badger *Read-o-Matic** register

eliminates the last big barrier to fast, efficient water meter reading

At last water meter reading has come of age. Badger's revolutionary Read-o-Matic brings it *out in the open* — the first practical *outdoor* register in the industry.

By separating the metering from the reading, and bringing the register itself up and out of the house, Badger offers faster, lower cost reading never before possible. Add still more benefits . . . long, service-free life . . . low initial cost . . . and simple installation . . . that mean tremendous savings in time and money as well as better service and customer good will.

For the first time, your water department will have a truly modern meter reading system . . . through the exclusive Badger Read-o-Matic.

RESIDENTIAL

NO MORE "lockouts"

NO MORE access problems

NO MORE in-house accidents

NO MORE inconvenienced customers

NOW 100% meter reading in ½ the time —and no wasted calls

Badger's Read-o-Matic makes the seemingly impossible *possible:* every call is a "mission accomplished." The meterman no longer depends on the customer to be home to take his reading. By ending the tedious, time-consuming phases of meter reading, the Badger Read-o-Matic makes it possible for every meterman to complete his metering route in half the time . . . completing every call *every time.*

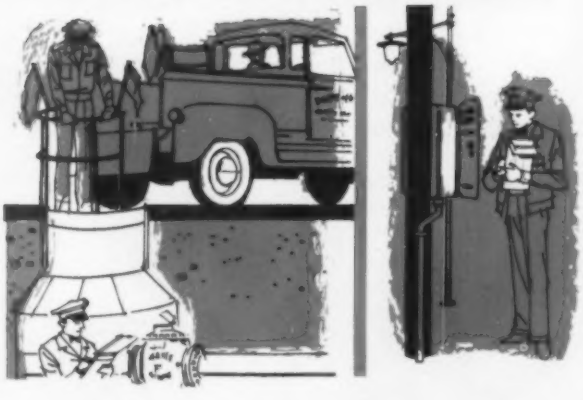
Strategically located reading stations for new shopping center

The Badger Read-o-Matic can be placed as far as one-half mile away from the meter itself. This makes it ideally suited for commercial use, and introduces a new concept in meter reading: the reading station.

No dream — this new concept will soon be operating in the Mayfair Shopping Center in Milwaukee, where 85 stores are served. Each store will have a meter at the service and another at each air conditioner. These meters will be connected to the central reading station for each section . . . for easy, convenient, rapid reading.

At right: Typical layout of central reading station serving 10 meters is outlined in color on aerial view.

Architectural drawings courtesy of Grasshold & Johnson, Milwaukee, Wis.



The Badger Read-o-Matic's easy access at all times effectively reduces reading costs, eliminates the time-consuming, sometimes dangerous chore of reading inconveniently located meters. In many cities, for example, large water meters are under the streets. Meter reading involves 3 men and a truck to barricade the street, flag down traffic and go down a manhole to read the meters.

FORECA

a centralized me covering several

Badger's Read-o-M of strategically loc — covering several entire community. could be done by o to corner reading s

ter
ne
lls

ssible
' The
to be
time-
Read-
an to
com-

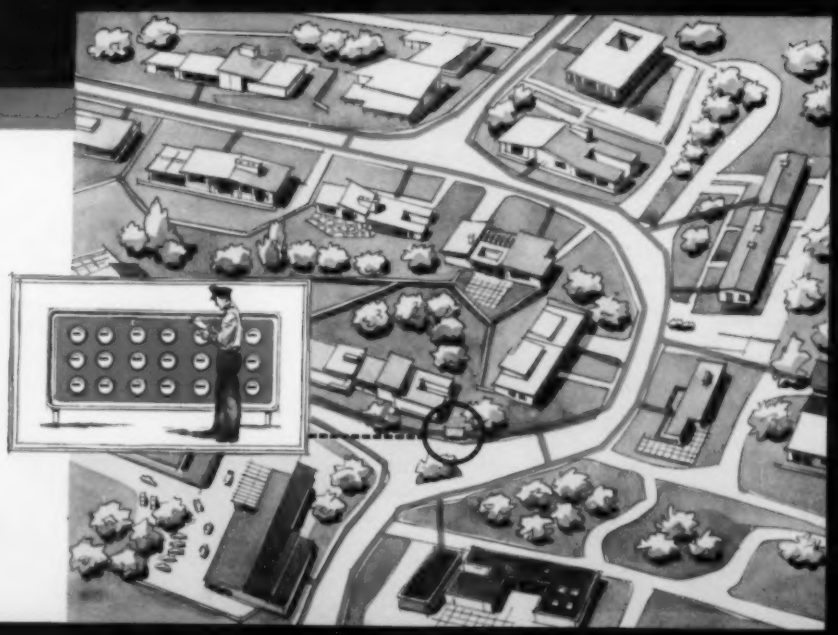
ed
or
er

one-
es it
new

ating
here
er at
These
ation
ding.
ation
view.

, Wis.

COMMERCIAL



RECAST

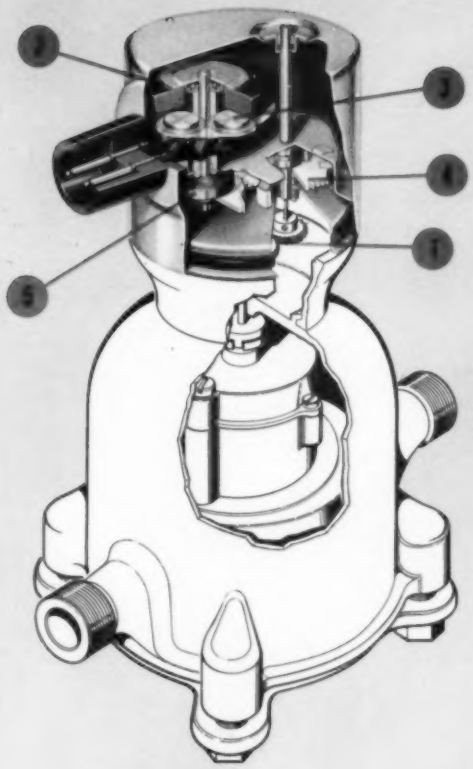
lized meter-reading station
several city blocks.

Read-o-Matic makes possible a system
ically located meter-reading stations
ng several city blocks throughout an
mmunity. The periodic meter reading
done by one man, making his rounds
reading stations.

Behind the revolutionary register . . . a self-contained generator

Operation is precise and fool-proof. The Badger Read-o-Matic is powered entirely by the meter to which it is attached.

Water passing through meter (see diagram at right) turns disc spindle to activate gears (1) that turn a magnet (2) in generator. This magnet rotates above 6 coils (3) that have poles within them. Drive gears (4) turn until they "run out of teeth." Immediately the driven gear is released under tension of torque spring (5). Quick escape of magnet generates the pulse on return kick of magnet over the coils and a three-volt pulse is transmitted by wire to Badger Read-o-Matic register.



Patents applied for in U.S.A. and foreign countries.

. . . the result of extensive torture tests — in the laboratory and in the field

Badger's trained staff of water meter experts were merciless in their testing of the Read-o-Matic. They exposed it to 25 degrees below zero . . . operated it submerged (generator entirely open and precisely driving <u>two</u> registers as pictured) . . . sent millions of gallons of water through pilot models to test accuracy at a distance of two miles . . . pushing for performances far beyond the ultimate demands of Read-o-Matic users. **And throughout all the rigorous tests, Badger Read-o-Matic never missed a pulse . . . never failed to accurately record every ounce of water that flowed through the meters.**

The Badger Read-o-Matic is simple to install and requires no outside power. Doorbell-type wire carries the pulse from generator in meter to Read-o-Matic register.

Research makes the big difference in the meters Badger builds . . .

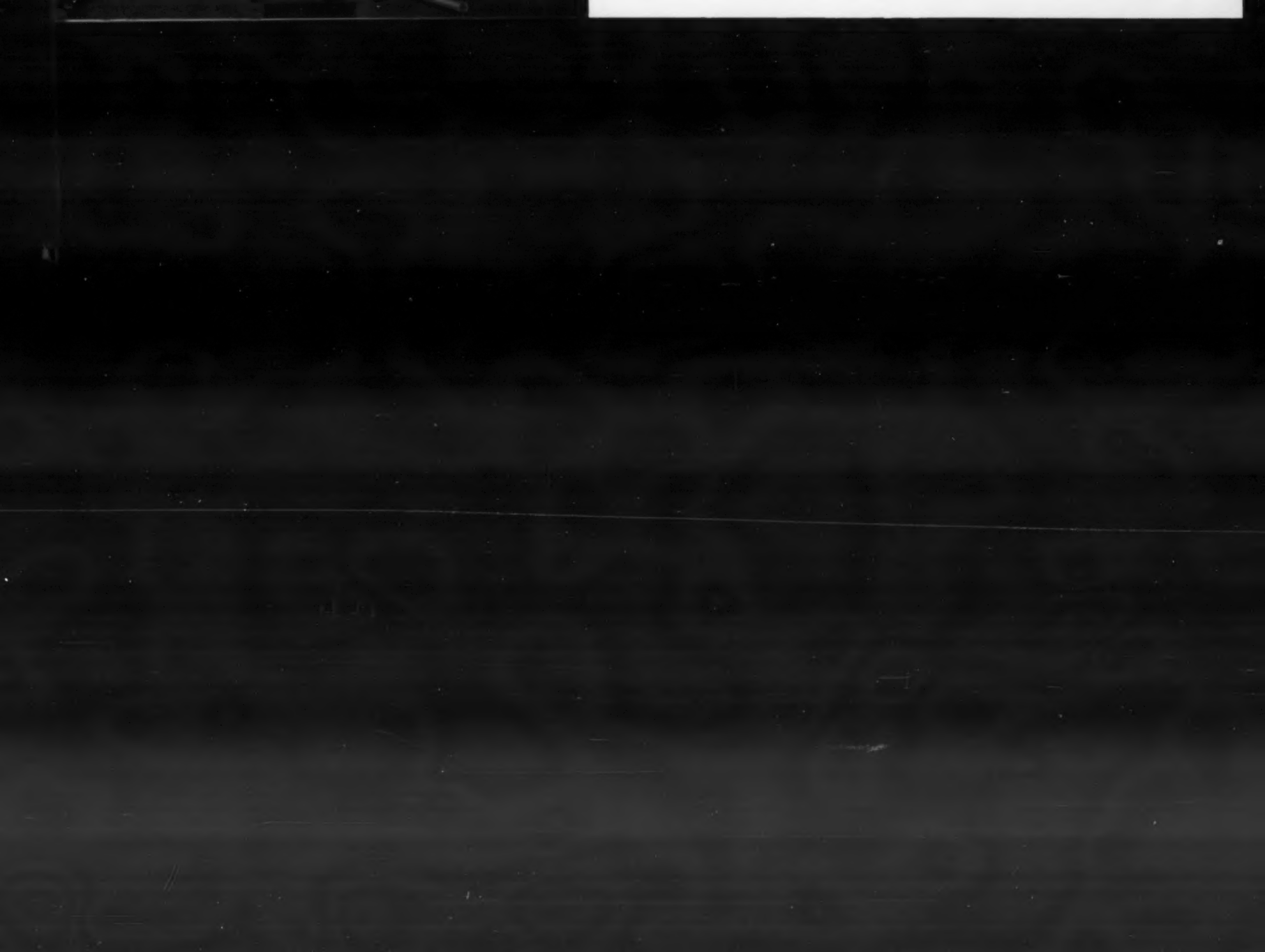
Here at our new 56-acre home in Milwaukee, research has paralleled Badger's 50 years of experience . . . *highly specialized water meter* experience . . . to develop meters that excel around the world in accuracy, durability, dependability and low maintenance cost. Here the precision achievements in water meter design are created and reach final production. From our engineering and research laboratories have come such Badger *firsts* as the self-locking anti-fog register cover . . . the exclusive Badger dovetail thrust roller insert . . . and now the remarkable new meter-register that finally brings meter reading *out in the open* — the Badger Read-o-Matic!

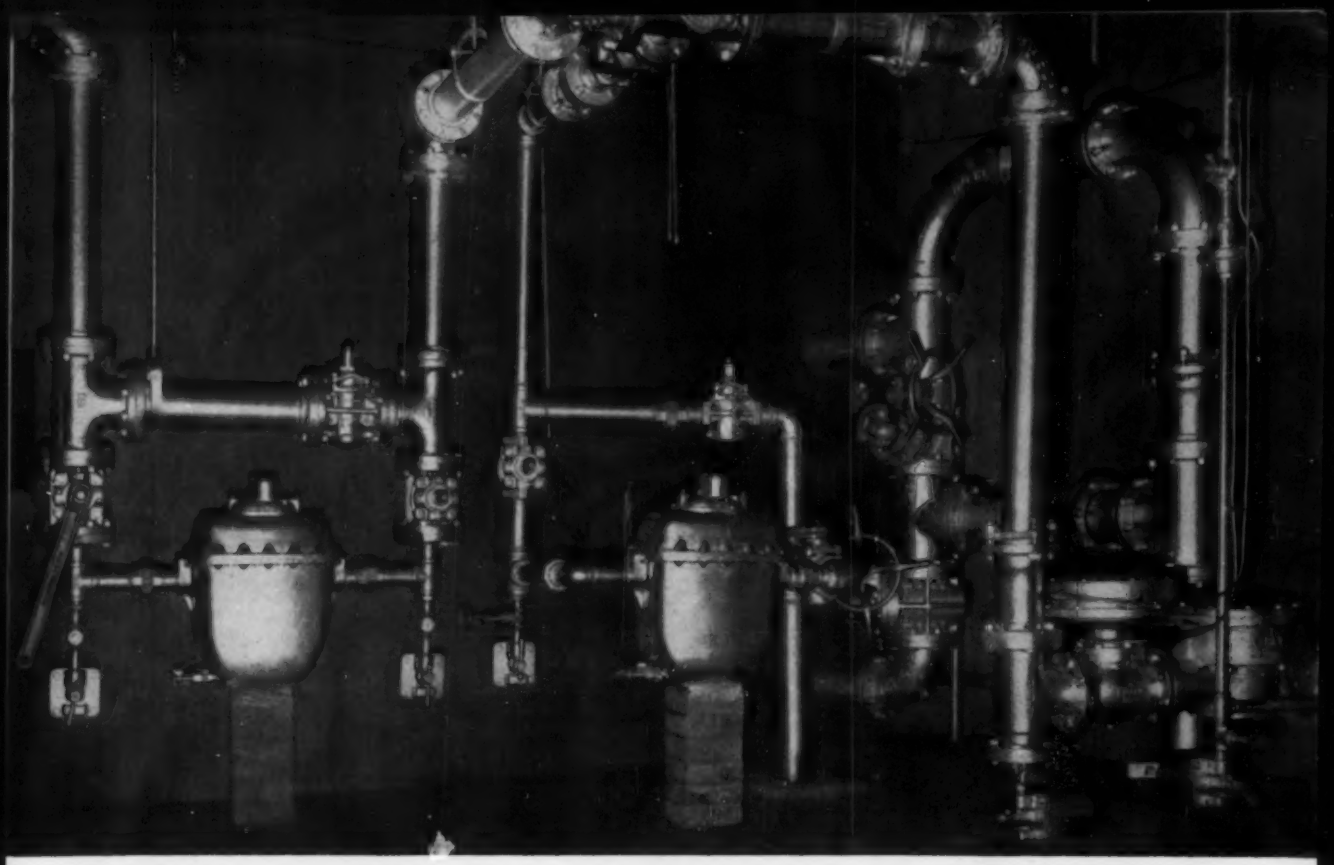
● *For further details or an actual Read-o-Matic demonstration, see your Badger representative — or write us direct.*

Water is Vital

Badger Water Meters

4545 WEST BROWN DEER ROAD • MILWAUKEE 18, WISCONSIN





WHAT'S THE BEST VALVE FOR SEWAGE GAS?

ROCKWELL-NORDSTROM LUBRICATED PLUG VALVES resist corrosive attack better, seal tighter and stay in service longer than any other valve you can use on sewage gas. Here's why:

Rockwell-Nordstrom lubricated valves are sealed by a tough, instantly replaceable "seat" of pressurized lubricant. The lubricant film not only protects the plug and body, but eliminates metal-to-metal wear for longer life, lower cost. And lubricant sealing with the tapered plug and Sealdport system means that seating surfaces are unexposed to corrosive attack.

The same benefits of better performance, longer life and lower cost assured by Rockwell-Nordstrom valves on sewage gas service apply to any valve in the sewage plant.

Rockwell-Nordstrom valves are available in a complete range of sizes and pressures with a wide range of operating accessories. They cost no more to buy, often less, than ordinary valves. See your supplier soon or write for the free booklet, C-5200. Rockwell Manufacturing Company, Pittsburgh 8, Pa.
Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES
it's **ROCKWELL**
MANUFACTURING COMPANY

Rockwell Manufacturing Co.
Pittsburgh 8, Pennsylvania

☐ Please send me Bulletin C-5200.
☐ Please have your sales engineer call.

Name_____ Title_____

Address_____

City_____ Zone_____ State_____

Our representative can explain to you how simplicity of design minimizes maintenance—and to see the R. D. Wood Hydrant you needn't leave your office chair.

"Don't Get Up! Sit Right Where You Are and Let Me Show You the R. D. Wood Hydrant"

"With this scale model I can show you why the R. D. Wood Hydrant has earned its reputation for reliability, strength and permanence. It is simple in construction, too—a fact that makes it low in cost and easy to repair in case of accident.

"The full area main valve is cone shaped to prevent water hammer. It opens *against* water pressure, so that if it is broken in a traffic accident, water pressure will hold it closed. This prevents loss of water, lowering of water pressure, and flooding."

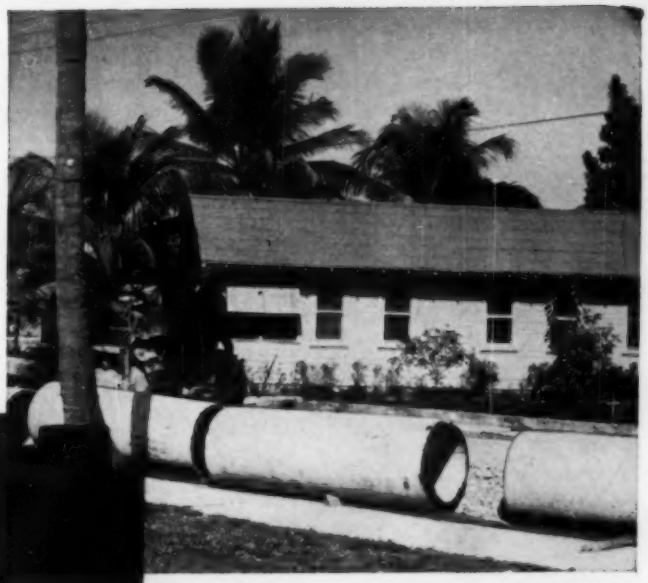
Would you like to see it? Our representative will bring in a scale model and show you its advantages right in your office. Drop us a line today and he will telephone you for an appointment at your convenience.

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

Look for TYLOX Rubber PIPE COUPLINGS



Where infiltration problems are "tough!"

In Miami

ENGINEERS AND CITY OFFICIALS DEFEAT FLORIDA'S SUBAQUEOUS SOILS WITH TYLOX JOINTS TO KEEP "OUTSIDE WATER OUT" OF NEW CITY SEWERS

Miami's choice of TYLOX Rubber Joints for new sewerage lines not only solved infiltration problems presented by high water tables, but sped completion of the project, kept construction costs down and assured long-lasting *leakproof* lines. Here's how . . .

MORE PIPE DOWN PER DAY, with *fast-working* TYLOX to offset slow working conditions. TYLOX Joints are safely made in wet trenches, and backfilling can follow *immediately*.

NO JOINT FAILURES — Rubber TYLOX seals under *compression* . . . angularities in the line — or stresses from shifting soils or surface loads — are compensated by the natural resilience of the rubber.

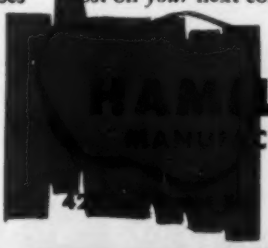
NO CORROSION — Made of specially compounded rubber, TYLOX Joints are immune to sewerage and industrial waste acids and alkalies. *TYLOX outlasts the pipe itself.*

Write for complete details and more case histories on TYLOX, the *one* pipe joint that meets requirements of engineers, sanitary officials and construction men alike. Read the *facts* for yourself, and specify TYLOX to prevent infiltration, speed construction and lower cost on *your* next concrete or vitrified clay pipe project.

PROJECT: *City of Miami — Sewerage Expansion*

PIPE: *Reinforced Concrete — Manufactured by United States Concrete Pipe Co., Cleveland, O.*

ENGINEERS: *For the City of Miami:*
Arthur E. Darlow, Director of Engineers
W. T. Eefting, Project Engineer, Design & Specifications
Robert Banning, Chief Construction Engineer
W. B. Lewis, Engineer of Designs

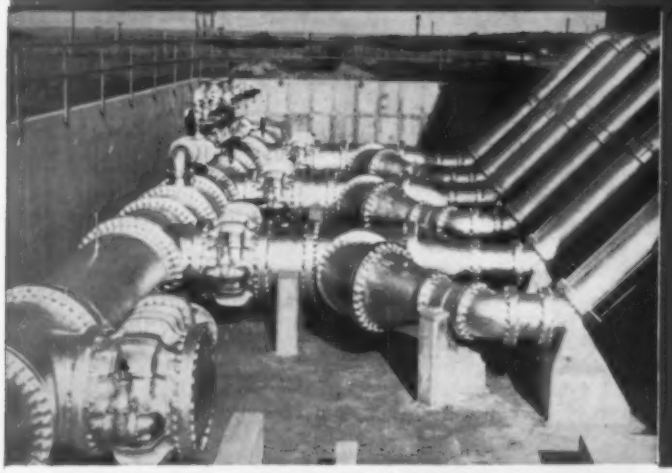


HAMILTON KENT MANUFACTURING COMPANY
Kent, Ohio
ORchard 3-9555

1900

"THE ONLY PERMANENTLY TIGHT LINES ARE LAID WITH RUBBER JOINTS"

STRENGTH PLUS



Chicago, Ill.—Cast Iron Pipe for installation of new water main under West Madison Street.

Corpus Christi, Texas—Cast Iron Pipe installation in filtration plant showing 48" discharge manifold which is connected to 48" Cast Iron city supply line.

THE MAN WHO CHOOSES
CAST IRON PIPE TODAY
WON'T PAY FOR IT AGAIN
TOMORROW!

CAST IRON

Cast Iron Pipe Research Association
Thos. F. Wolfe, Managing Director
Suite 3440, Prudential Plaza, Chicago 1, Ill.

MODERNIZED **cast iron**

HIGH FLOW

You get BOTH with CAST IRON PIPE

*Here's the proof of flow

FLOW FACTORS FOR CEMENT LINED CAST IRON PIPE

LOCATION	SIZE	TEST SECT. IN FEET	VELOCITY F.P.S.	AGE YEARS	W & H "C" FACTOR
Bowling Green, Ohio	20"	45,592	0.7-2.4	New	142.5
Chicago, Illinois	36"	7,200	2.6-3.6	New	147
New Orleans, La.	12"	39,650	1.2-2.9	New	141
Corder, Mo.	8"	21,350	0.9-2.3	New	143
Univ. of Illinois	8"	400	3.14	New	150
Concord, New Hamp.	14"	500	1.7-2.2	New	151
Concord, New Hamp.	12"	500	2.0-3.4	11	142
West Palm Beach, Fla.	12"	500	3.6-5.4	15	139.5
Greenville, S. C.	30"	87,376	2.4-2.7	12	148.5
Corpus Christi, Tex.	30"	65,641	1.1-1.8	6	146
Summerville, S. C.	8"	500	1.98-2.43	13	142.5
Champaign, Illinois	16"	3,920	3.1-5.6	22	139.3

*Available upon request: Booklet containing flow test and tables on Cast Iron Pipe.

Here's the proof of strength

1. CRUSHING STRENGTH* . . . Standard 6" Class 150 cast iron pipe will withstand a crushing load, under standard tests, of 17,900 pounds per foot . . . important where heavy fill or shock from heavy traffic loads are encountered.
2. BEAM STRENGTH* . . . Settlement soil movement, or disturbance of the soil by underground construction places a heavy strain on pipe. A length of 6" class 150 cast iron pipe bears up under a load of 20,790 pounds and deflects over 2¼ inches.
3. BURSTING STRENGTH* . . . Tests prove that standard 6" class 150 cast iron pipe withstands internal pressure of 3000 pounds per square inch . . . providing a safety factor ample to resist high working pressures and water hammer.
4. JOINT STRENGTH . . . A full range of leak-proof, low cost, easy-to-assemble joints for pipe and fittings are available to meet all conditions.
5. CORROSION RESISTANCE . . . Cast Iron Pipe resists corrosion . . . vital factor in its proven long life and dependability.

*Based on independent laboratory tests.

pipe FOR MODERN WATER WORKS

In Oakland, California,

Main entrance to the East Bay Pumping Station. Engineering and erection of the entire sewage system was handled by the East Bay Municipal Utility District Engineering Staff.

Four of the five Chapman Tilting Disc Check Valves installed in treatment plant of East Bay System. Each of these five valves has an average dry-weather flow of 55,000,000 gallons daily. Maximum flow for the plant is approximately 300,000,000 gallons daily.

55 million gallons per day flow quietly through five trouble-free

CHAPMAN

TILTING DISC

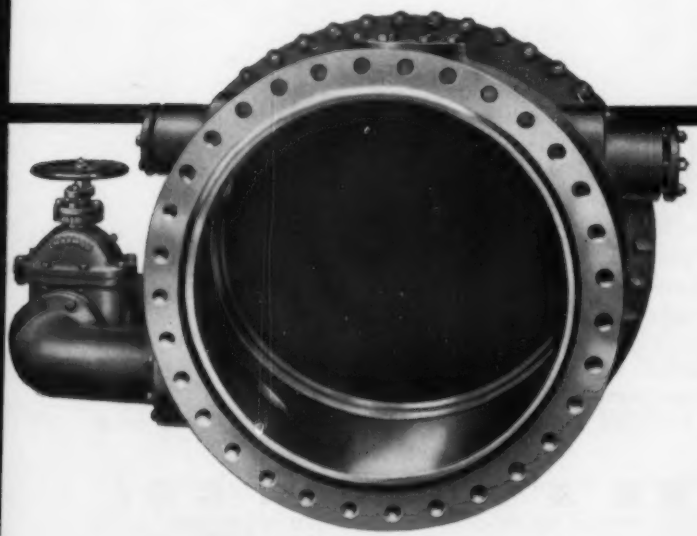
CHECK·VALVES

In Oakland, California, the East Bay Sewage Disposal System serves the cities of Oakland, Berkeley, Alameda, Albany, Emeryville and Piedmont. And it serves them well. It has improved health conditions and property values in the large East Bay area.

Representing an investment of $23,500,000 this system is modern in every respect. Twenty-one miles of reinforced concrete pipe bring sewage from six cities to the central treatment plant. At the treatment plant sewage is immediately chlorinated for odor control then raised 35 feet by five 42-inch pumps to the Grit Chambers from where it can flow by gravity through the rest of the system.

Finely screened sewage is pumped up through five 42-inch Chapman Tilting Disc Check Valves to prevent any return of the sewage to the Interceptors. Today, the average flow through these five valves is 55,000,000 gallons per day, with some variations. Yet, no matter how much it varies these Chapman Valves handle the flow quietly . . . no flutter, no slamming, no banging, no damage to valve or system. The valves automatically adjust themselves to the volume of the flow.

Chapman Tilting Disc Check Valves were the first with this unique design, engineered to meet standard and unusual conditions of service. Chapman know-how is one of the many reasons why its valves and control equipment are selected for installations of all kinds. Write, and one of our engineers will tell you more of the ways and whys.



Left: — Chapman Tilting Disc Check Valve with 6″ bypass connection similar to the Chapman Check Valves installed in the East Bay Sewage Disposal System.

Why not send for our free Catalog No. 30-B showing and giving full information on all Chapman Tilting Disc Check Valves.

The **CHAPMAN** *Valve Manufacturing Company*

INDIAN ORCHARD, MASSACHUSETTS

For over 75 years, Chapman has devoted its entire facilities to the valves of today and tomorrow. Chapman has the engineers, metallurgists, experience and manufacturing facilities to design, develop, build and test the valve equipment you need no matter how tough the requirements.

All that fuss about a well...

Seems that one day they tested the town well and said it was polluted. Imagine! Our well . . . polluted! Why that well had been serving our town water since Hector was a pup.

So they had a big fuss and then they built a little shed and put a chlorinator in it. Well, they claimed the water was pure, but it tasted *awful*. And the smell around that shed gave the whole town a bad name. Of course, that was only half the time . . . it was being repaired the other half.

Then we gave up. Put in a new kind of chlorinator made by a company I never heard of . . . Fischer & Porter. Talk about spic and span! You could eat off that box. And not only is the smell gone, but believe it or not, the water *tastes* better. They say it's even safer.*

Now you don't have to take *my* word for it. If you're a suspicious kind of person you can get all the proof you want by writing to Fischer & Porter Company, 188 Fischer Road, Hatboro, Pennsylvania.

FISCHER & PORTER CO.

Instrumentation and Chlorination

*Any wonder everyone's *trying* to copy F&P's design now?

HERSEY WATER METERS

are preferred by experienced Water Works Officials and Engineers.

Get detailed information on the most complete line of Water Meters in the world from our nearest Branch Office or Home Office.

HERSEY MANUFACTURING COMPANY

(Established 1859)

DEDHAM, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO SAN FRANCISCO — LOS ANGELES

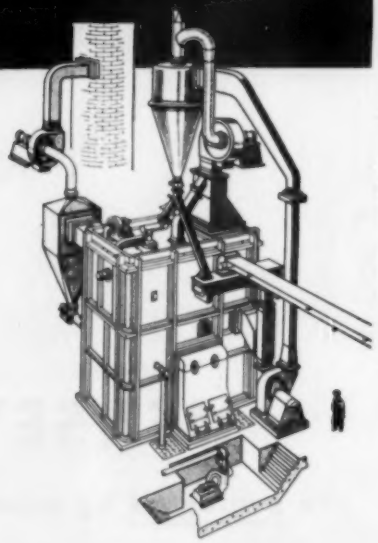
Dispose of Sewage Sludge the Modern Way

The widespread acceptance of the C-E Raymond System is based on its solid advantages. This compact system combines the principles of Flash Drying and Incineration in a unit in which filter cake can be reduced to a sterile ash . . . or flash-dried to a salable fertilizer and soil conditioner. Revenue from the latter is often sufficient to pay a substantial part of plant operating costs.

Either operation can be performed alone, or combined in any desired proportion. Effective high-temperature deodorization of stack gases is available for both processes.

A C-E Raymond System can mean an end to your community's sludge disposal problems . . . as it has in municipalities across the nation. Contact the Combustion office nearest you for specific recommendations. A C-E specialist will be glad to discuss your requirements and help plan an installation with you or your consultants.

B-9988



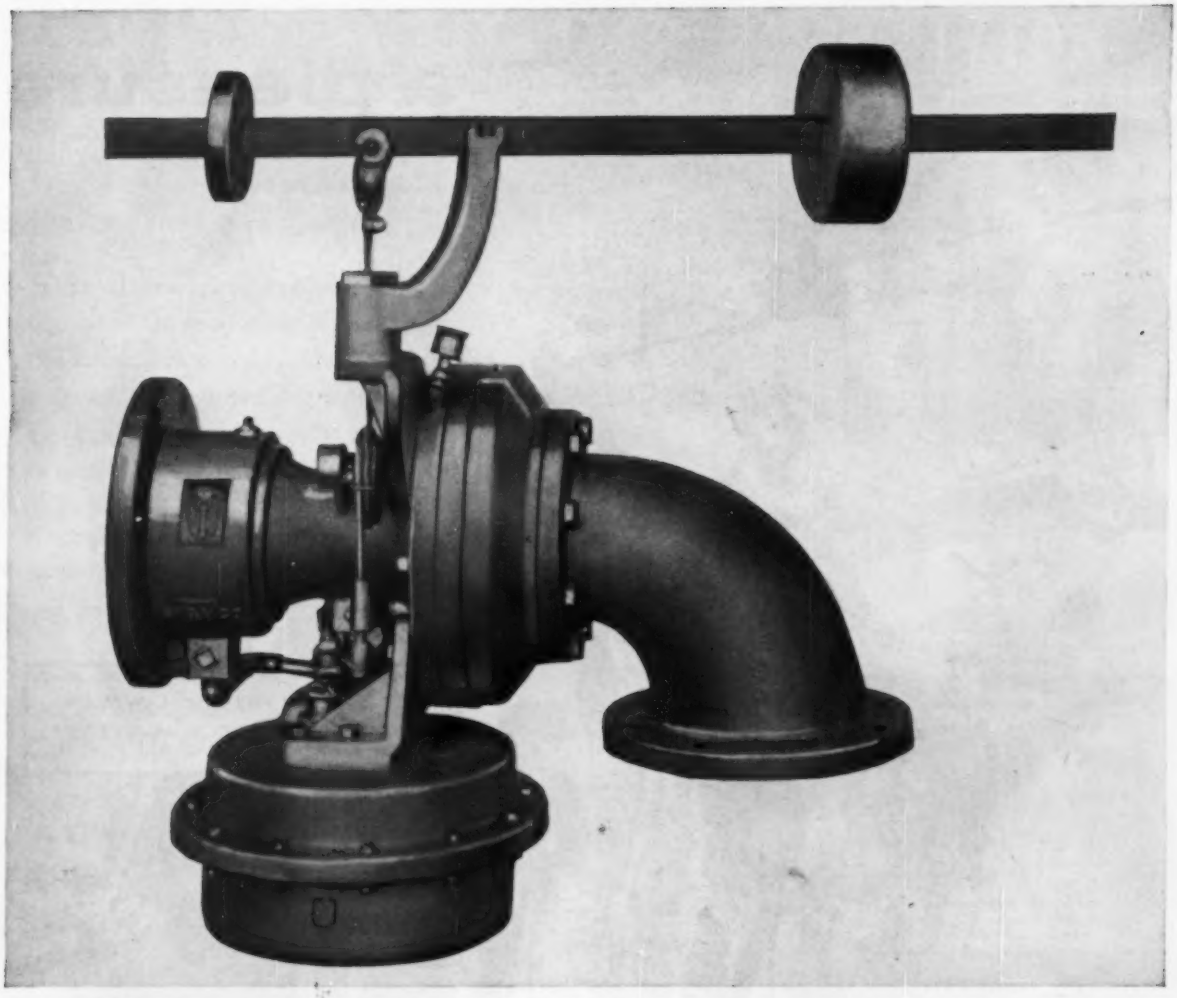
COMBUSTION ENGINEERING

RAYMOND DIVISION, 1315 North Branch Street, Chicago 22, Illinois

Eastern Office: 200 Madison Avenue, New York 16, N. Y. • Western Office: 510 West Sixth Street, Los Angeles 14, Cal.

Canada: Combustion Engineering-Superheater Ltd.

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL



Direct-acting!

SIMPLEX "S" CONTROLLERS

keep filter rate uniform without outside power sources

Important? Yes! Because it eliminates the danger of run-away filters when power sources fail. In addition, you get continuing accurate control to the wide-open position . . . for longer runs. You save on pumping with full-area opening . . . and no flow obstructions at the wide-open position.

Compact Type "S" Controller is only three pipe diameters long. Fits anywhere—horizontally or vertically. Eliminates expense of straight-pipe approaches. Proven by twenty-five years' trouble-free service. And with virtually no maintenance—saves you money in the long run.

MAIL THIS COUPON TODAY!

SIMPLEX®
VALVE AND METER COMPANY
A subsidiary of PFAUDLER PERMUTIT INC.
Venturi Tubes • Flumes • Meters • Gauges
Transmitters • Controllers • Tables • Air Valves

SIMPLEX VALVE & METER CO.
DEPT. WS-8, 7 East Orange St.
Lancaster, Pa.

Send me new technical bulletin 900 that gives valuable design and performance data on Filter Controllers and Master Control Systems.

NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

a pleasure

U.S. cast iron PIPE

FOR WATER, SEWERAGE AND

to handle!

True. A balky wife can be a problem.
But Tyton Joint® pipe . . . never!

In fact, Tyton Joint pipe is so easy to assemble that even inexperienced crews pick up the know how quickly. Only one accessory needed—a specially designed rubber gasket that seats into the bell. The connecting pipe slides in, compresses the gasket to give a tight, permanent seal.

No bell holes. No caulking. No nuts or bolts to fasten. And Tyton Joint pipe can be laid in rain or a wet trench.

Want full details on how Tyton Joint pipe can save *you* money, time and trouble? Call or write today.

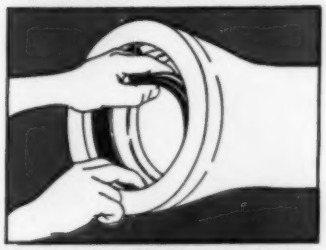
U. S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE

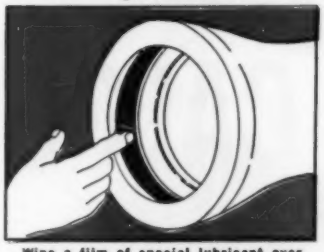
INDUSTRIAL SERVICE CAST IRON

TYTON JOINT

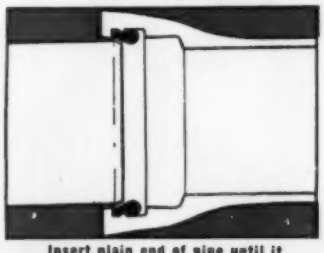
ONLY FOUR SIMPLE ACTIONS



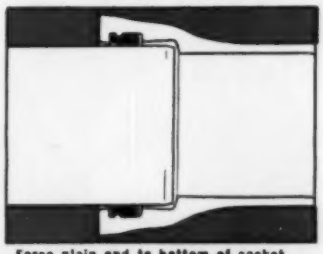
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket

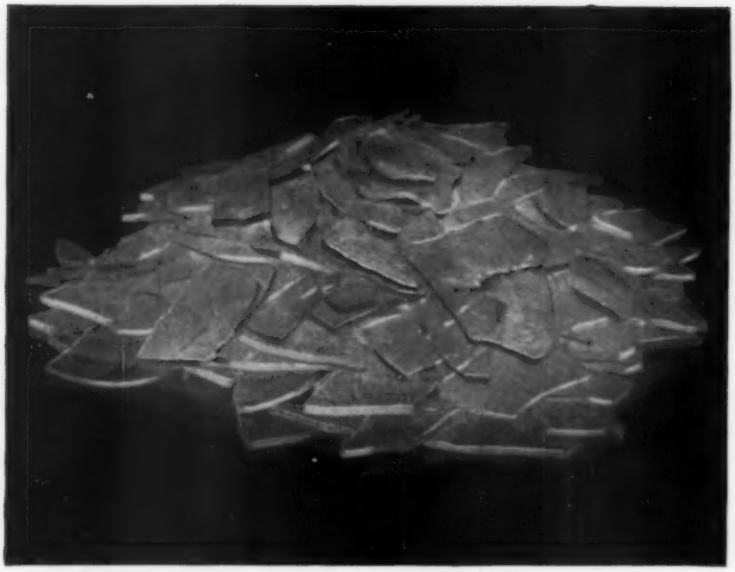


Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket .. the job's done!

6" Tyton Joint pipe for golf course sprinkler system in Illinois



CALGON®

CONTROLS

TUBERCULATION

Tuberculation cuts down flow capacities . . . raises pumping power requirements . . . steps up costs. Calgon provides the simple, economical way to control this costly corrosion.

Calgon treatment is particularly effective after mechanical main cleaning because of its fast film-forming ability. Protection for freshly scoured metal surfaces is quickly built up and easily maintained. Calgon treatment is as inexpensive as it is effective—a few ppm control tuberculation and other corrosion problems as well.

A letter or phone call will bring you more information on how Calgon can help. Or, an experienced Calgon engineer will be glad to make detailed recommendations on your specific problem.

CALGON COMPANY

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

BRING ON YOUR RIVERS!

CLOW RIVER-CROSSING CAST IRON PIPE TAKES 'EM "IN STRIDE"!

EASY TO LAY. As easy to make up as a standard flanged joint. Lower labor installation cost because of ease of joint make-up and longer laying lengths.

ONLY A RATCHET WRENCH NEEDED. No split parts. Fewer parts—each joint consisting of one complete pipe, one solid follower ring, one solid ring gasket, bolts and nuts.

FULL 15° TURNING DEFLECTION with absolutely no reduction in the full internal opening area—therefore, no abnormal pressure-drops at deflected joints. Deflection stresses evenly distributed among all the bolts.

LONGER LAYING LENGTHS—approximately 18'6"—faster installation, lower costs. However, lengths may be varied to suit conditions. For example: 6 foot, 12 foot or other special lengths may be advisable to suit required curvature.

Mail coupon for complete information on Clow Ball-and-Socket River-Crossing Pipe. No obligation, naturally.

JAMES B. CLOW & SONS, Inc.

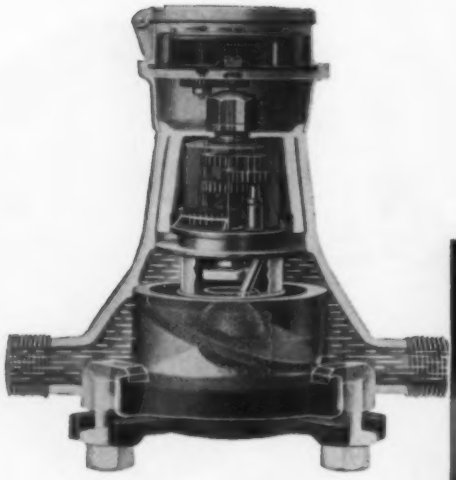
201-299 North Talman Avenue • Chicago 80, Illinois

Subsidiaries:
Eddy Valve Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Iowa

JAMES B. CLOW & SONS, Inc.
201-299 North Talman Avenue
Chicago 80, Illinois

Please send me, without obligation, details and specifications of Clow Ball-and-Socket River-Crossing Pipe.

Company_____
Street Address_____
City_____ Zone____ State____
Individual's Name_____
Position_____



HOW TO DEVELOP MORE *EFFICIENCY* IN YOUR METER SHOP

When a meter man learns one Trident, he learns them all. Instead of spreading his knowledge thin over many types and models of household meters, he can concentrate on the fine points of just one, and can quickly learn to do a job of which he can be proud.

Trident interchangeability is the big reason. Parts made for the most up-to-date Tridents are designed to fit into any older Trident of the same size and type. Reordering and stock control are simplified, too. No need to keep parts for many models. Just stock a small supply of the latest Trident parts.

You need never scrap a Trident because it is a "discontinued" model. In the process of replacing work-worn parts with new, improved parts over the years, you actually modernize all the Tridents in your system.

This 50-year policy of Trident is your best assurance that the modern Tridents you buy today will earn maximum revenue for your utility . . . with lowest yearly costs . . . for many years to come. Standardize on Trident meters. It pays in many ways.

It takes money to maintain the water supply your community expects. It's vitally important to make sure all the water pumped is paid for . . . by using accurate meters . . . and by keeping these meters in good repair.

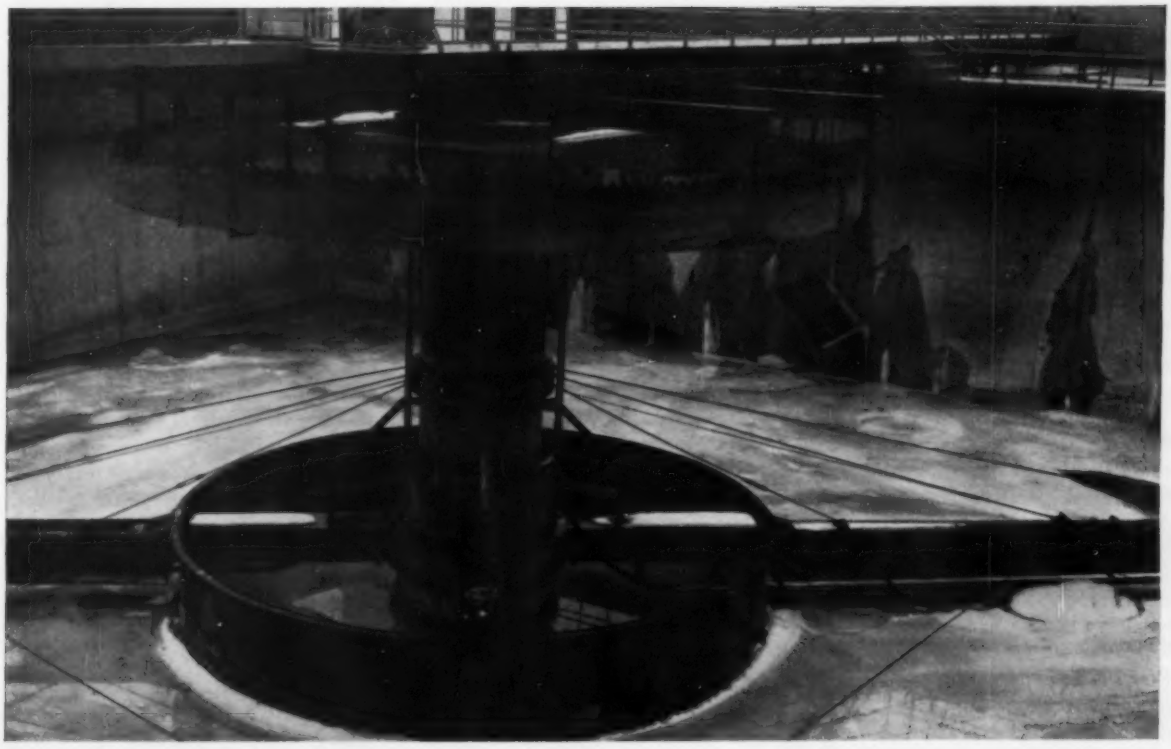
NEPTUNE METER COMPANY
19 West 50th Street • New York 20, N. Y.
NEPTUNE METERS, LTD.
1430 Lakeshore Road • Toronto 14, Ontario
Branch Offices in Principal American and Canadian Cities.

neptune
TRIDENT WATER METERS

Vol. 105, No. 8 · August, 1958

WATER & SEWAGE WORKS

A Scranton Gillette Publication



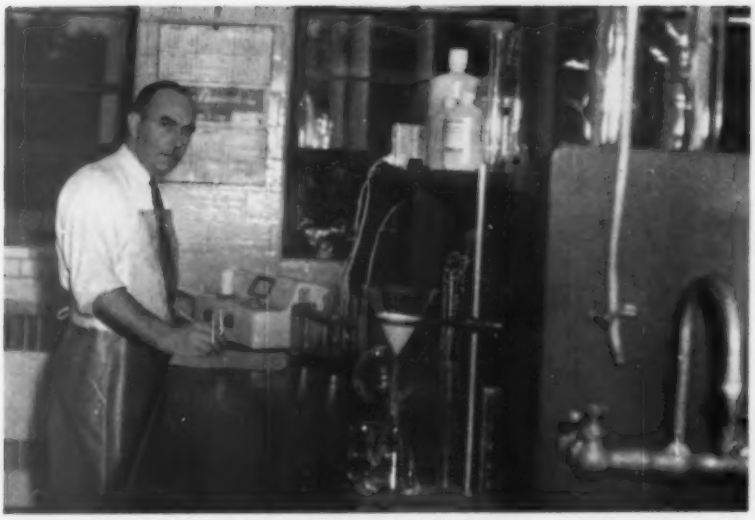
IMPORTANT PART of equipment in water at Eau Claire, Wis., is Dorr-Oliver "Hydro-Treator" used in . . .

Split Flow Treatment

by LLOYD V. OWENS, Plant Chemist, Water Works Division, Public Works Department, Eau Claire, Wis.

RESUME: Water treatment problems arising from well supplies, which varied from well to well in chemical composition, were solved by inaugurating split treatment iron and manganese removal process. The process consists of treating water from those wells containing iron and manganese in upflow coagulation basins and mixing the effluent with untreated water from other wells. Activated silica is used as a coagulant aid. A stable water is delivered to the consumers by this process, and costs of operation were reduced. This article describes the problem, the experimental study, the plant, present operation, and the results obtained from split treatment.

■ IN THE BEAUTIFUL Chippewa River Valley at the junction of the Eau Claire and Chippewa rivers, in west central Wisconsin, lies the industrial city of Eau Claire. Founded in 1832, the village of Eau Claire was incorporated as a city in 1872. It was from Eau Claire that Company "C", 8th Wisconsin Regiment, embarked for the Civil War with the famous eagle "Old Abe." During the early years, the infant city thrived and expanded as a result of the lumber industry.



AUTHOR OWENS at work in the plant laboratory.

At the peak of the logging era in this section of the State, Eau Claire enjoyed the distinction of having more sawmills than any city in the world. At one time, the city is reputed to have had some 35 mills in operation. As the lumber industry moved westward, new industries took over, and today we boast a United States Rubber Co. plant, which produces the US Royal Tire, and is among the most modern in the world. This huge industrial plant uses nearly half of our water consumption. Other industries here are the National Presto Co., the Sterling Pulp and Paper Co., White Machine Works, Armour and Co., and many other smaller industries.

As the city expanded, it became necessary to install a central water supply system. The first franchise was granted to the well-known Fairbanks-Morse Co. in 1885. Manganese was a problem from the start and there is a long history of different sources of supply until the present well field was established in 1934 on the east shore of the Chippewa River.

The movement to the present well field did not solve the manganese problem but rather delayed the inevitable construction of a treatment plant. During a period of years, a heavy deposit of manganese and some iron had deposited in the water mains and services to such an extent that the diameters were considerably reduced. Consumers were often troubled with "black water" which was created by the manganese deposits sloughing in the mains.

Treatment Plant Constructed

After many years of delay, an iron and manganese removal plant, designed by Alvord, Burdick and Howson, of Chicago, was constructed and placed in operation in March, 1955. The original plant design (Fig. 1) consisted of two 12 mgd Dorr-Oliver Hydro-Treators, followed by 4 rapid sand filters each having a capacity of 6 mgd. Two Omega lime slakers were employed for slaking the quicklime and delivering it to the Hydro-treators.

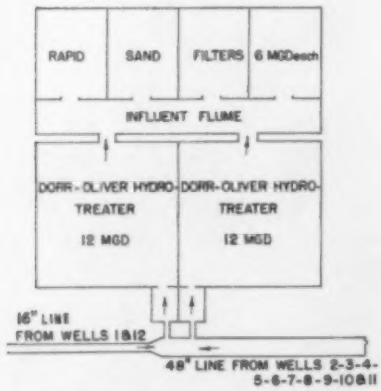


FIG. 1—Layout of original plant designed by Alvord, Burdick and Howson.

The plant was designed for use without a coagulant aid and trouble was immediately experienced in forming a sludge blanket in the upflow treatment units. Dorr-Oliver, Inc. studied the problem from April until September of 1955, using such aids as alum, artificial clay, calcium carbonate and similar methods with no success. At last it was decided that activated silica was the solution and in September we began feeding batch-mixed ammonium sulfate activated silica. The effects were immediate and a blanket was established within a few days. A few months later, two Wallace and Tiernan Silactors were installed for feeding activated silica.

A constant rate of flow was maintained through the treatment plant, making up the difference in water demand by bypassing with raw water from the wells containing the lowest alkalinity. Although the final effluent was not stable, it was an improvement over the previous treatment method.

Plant operation continued on this basis until the latter part of December when consultants from the Dearborn Chemical Co., of Chicago, were retained to work with the laboratory personnel at the treatment plant in an effort to seek a solution to the unstable water problem. All wells were again routed through the plant and our troubles were renewed in trying to keep a blanket in the Hydro-Treators, despite the use of heavy dosages of activated silica. In the meantime, calcium and magnesium carbonates, along with silica, were causing heavy deposits in hot water lines, hot water tanks, heat exchangers, and boilers, creating an acute condition in the industrial plants as well as in the homes of our consumers. Table 1 shows a typical analysis of the water.

Table 1

Typical Analysis in Heat Exchanger—U. S. Rubber Co.

Analysis	Before Split Treatment		Immed. After Split Treat.		6 Months after Split Treat.	
	Cold	Hot	Cold	Hot	Cold	Hot
Hardness	82	68	68	80	66	66
Alkalinity	72	64	54	62	50	50
Calcium	58	53	44	51	42	42
Magnesium	24	15	24	29	24	24
Silica	14.8	12.5	12.5	16.0	12.5	12.5
pH	9.48	9.42	7.58	7.98	7.85	7.85

Various methods were attempted to produce a stable water in a pilot plant, using different chemicals such as potassium permanganate and low lime dosages, high lime dosages to precipitate magnesium, and sequestering calcium with sodium hexametaphosphate, and many other types of treatment. In any case, the quality of water was either undesirable or the cost of treatment was prohibitive.

Split Treatment Recommended

After many weeks of experimentation, the author evaluated the entire situation and made recommendations for a true split flow treatment method in February, 1956, based on the following information compiled over the months of initial plant operation.

1. A blanket could not be maintained in an upflow treatment unit using a low alkalinity raw water. Jar tests conducted at the laboratory (see Fig. 2 and 3) indicated that, when no reduction in hardness and alkalinity could be effected by lime treatment, the water was unsuitable for treatment. There appears to be a rather definite limitation of minimum alkalinity in raw water that can be successfully treated in upflow treatment units of this type. This minimum range appears to be in the vicinity of 60 to 70 ppm.
2. A closer study of the well field revealed that, in most cases, all wells containing iron and manganese were the high alkalinity wells, whereas the low alkalinity wells were those comparatively free of iron and manganese. Mapping out the well field, and reviewing the history of each well, it was found that the iron and manganese free wells had remained that way for years, one well being some 15 years in use. This caused speculation as to the two different sources of water. The wells are arranged, by chance, so that all the iron and manganese free wells can be routed separately from the other wells, permitting us to bring only the affected iron and manganese wells into the treatment plant.
3. Since we were producing a final effluent with an average pH of 9.85, the cost of CO_2 for stabilization would be high. A split flow method of treatment would greatly reduce, if not eliminate, the need for carbon dioxide.

OPERATOR Jack Walsh adjusts Omega lime slaker in treatment process.

The original recommendations for split flow treatment were submitted to City Manager David Rowlands, Public Works and Utilities Director Neal Bartholomew, Alvord, Burdick and Howson, and the Dearborn Chemical Co. These recommendations included the following outlined procedure:

1. Only the iron and manganese bearing wells were to be treated in the plant.
2. Bypass the treatment plant with the iron and manganese free wells and mix with the treated water in the clearwell.
3. Balance out the pumpage rates to constitute approximately a 50 per cent mixture from each source.
4. Install recarbonation facilities for pH control, when and if needed.

The recommendations met with a certain amount of resistance until finally in March, 1956, after all other

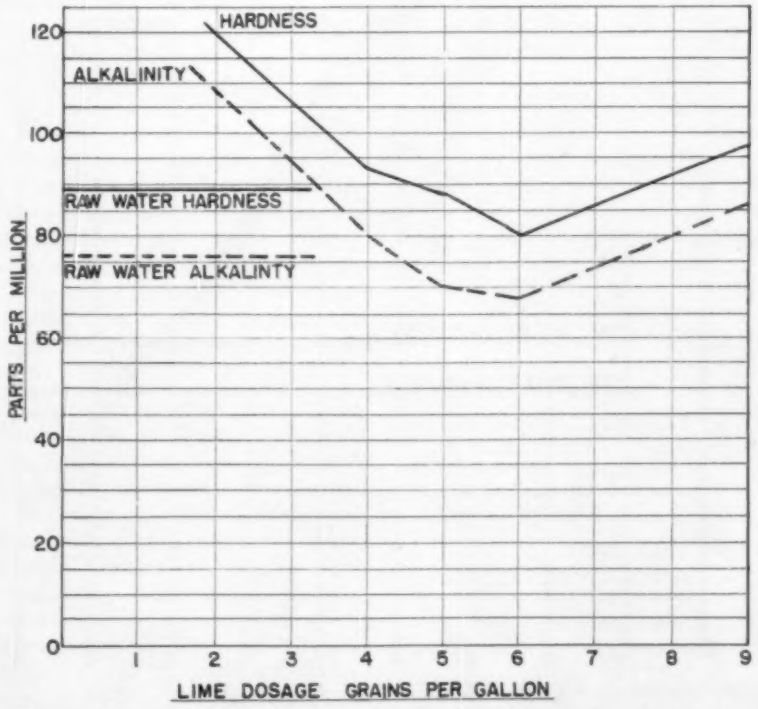


FIG. 2—Hardness and alkalinity of well No. 5 water after lime treatment.

MODIFICATION of plant for split treatment required two inlet pipes. Standing on pipes are (left to right): Neal Bartholomew, Dir. of Pub. Works & Util.; Douglas Weiford, City Manager; Casper Barney, Supt. of Water Div.

reasonable experiments failed to produce results, the split flow treatment plan was placed in operation. From the very first hour of operation, the water quality improved, as did the sludge blanket in the Hydro-Treator. It was not until May that the entire plan was put into effect as it was recommended, and the results were even more encouraging.

The original split treatment process involved mixing the raw and treated waters in the clearwell and in the suction lines to our equalizer and high lift pumps. There was some concern over the possibility of an "after-precipitate" forming as the result of mixing the two waters without the benefit of filtration. Laboratory attempts in mixing raw and treated waters produced no evidence of such a precipitate and so far there has been no such formation in the system.

Before the split treatment process was employed the unstable finished water caused deposition when heated. When we first began producing a stable water, the deposits in the water tanks dissolved in the hot water, picking up calcium and magnesium carbonates and silica. (Fig. 4). This condition continued for several months until the old deposits were gradually dissolved. The cold water going into the water tanks is now essentially the same in characteristics as the hot water withdrawn, indicating that the water remains stable when subjected to relatively high temperatures.

Treatment Plant Modifications

After operating on the split treatment process for several months, plans were drafted by Alvord, Burdick and Howson which would improve the process by utilizing one of the Hydro-Treator basins for the raw water from the iron and manganese free wells while treating the water from the wells containing iron and manganese in the remaining basin.

Mixing of the raw and treated water was accomplished by installing a baffle wall in the influent flume which provides a mixing area and serves to detain the mixture somewhat before it reaches the filters. (Fig. 5). Recarbonation presented a problem because the original plant design did not include these facilities. A unique carbon dioxide diffuser, designed by plant personnel, which permits feeds upwards to 50 pounds per hour with high absorption rates, was installed at the inlet to the mixing flume from the basin being used as a treatment unit.

These plant modifications effected many advantages to the split treatment process. The installation of two separate inlets for raw water adds to the flexibility of plant operation. Should trouble be encountered with the present Hydro-Treator in use, the raw water can be diverted from the basin directly to the influent flume and the other Hydro-Treator placed in service with no interruption in the split treatment process.

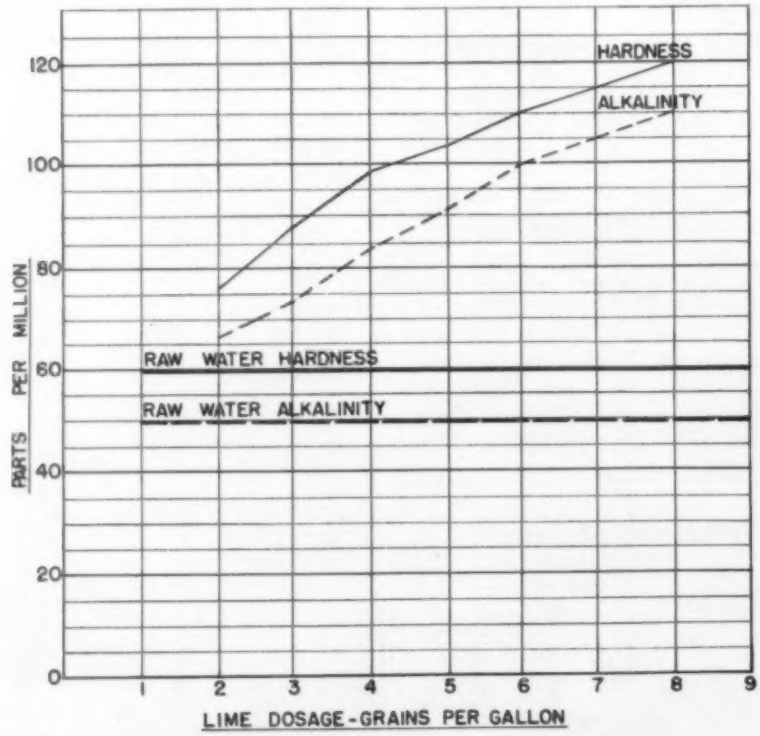


FIG. 3—Hardness and alkalinity of well No. 8 water after lime treatment.

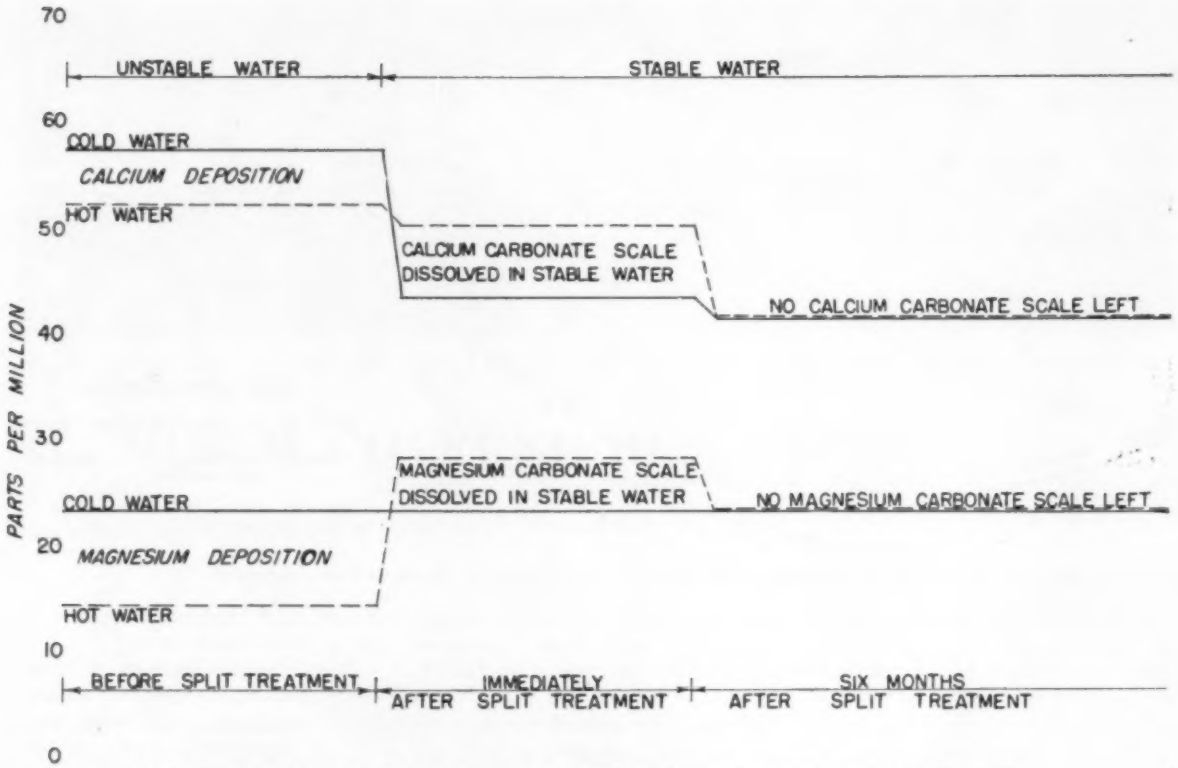


FIG. 4—Analysis of heat exchanger at U. S. Rubber Co., before and after split treatment.

Since we are troubled with algae in some wells, it is desirable to filter all the water, which is possible with the modifications made to the plant.

Another advantage is that all the water in the clearwell is of the same characteristic, hence the lowering or raising of the clearwell level will not affect the water quality. Before the modifications were installed, if the water began to accumulate in the clearwell, the effluent being pumped to the mains would show a drop in pH, as the filtered water was being stored and the entire supply of bypass water was being pumped out into the system thereby upsetting the ratio of the raw water to treated water.

The reverse was true if the water was being pumped faster than it was produced, which caused a lowering of the clearwell level, throwing off the balance of the mixture to give us a high pH water. Another possible advantage is that, should we pick up some iron in the raw water from the bypass wells, there is a possibility that some precipitation may occur when it is mixed with the high pH treated water. This precipitate would be conveniently removed by the sand filters.

Water Source

When the split treatment plan was presented, there existed doubts as to the length of time it might be successful, depending upon the iron and manganese free wells remaining as such. There also existed a belief that all wells, when first placed in operation, contained no iron and manganese, but gradually developed these undesirable minerals upon continued withdrawals of water. Accurate records of early wells operations not being available, a map of the entire well field was constructed, zoning the area by well characteristics, (Fig. 6) based on known analyses for the past seven years.

Three district areas appeared as shown by the various zones. In zone "C", which includes wells 8, 9, 10, and 11, no iron and manganese appeared in the water and the alkalinity was low. In zone "A", nearest the river, in which wells 1, 2, 4, and 5 are located, heavy concentrations of iron and manganese existed along with high alkalinities. The area between zones "A" and "C", which is designated as "B" zone, contained water which was characteristic of either of the adjacent zones. Wells in this area are 7, 3, and 6. No. 7 well, which has a relatively high alkalinity, occasionally shows traces of iron and manganese; this well has now been in use about 17 years. No. 3 well, which has a very low alkalinity, is sometimes very high in iron and manganese. No. 6 well, constructed in 1955, contained iron and manganese when first used, but for several months now has shown none. This well, like 3, has a very low alkalinity. (See Table 2).

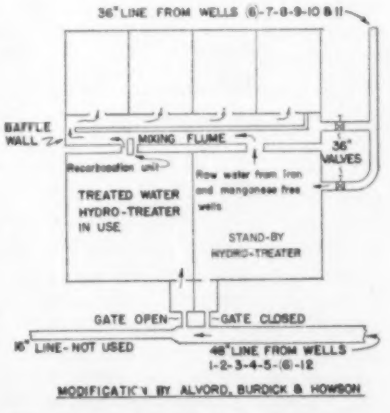


FIG. 5—Layout of plant modification

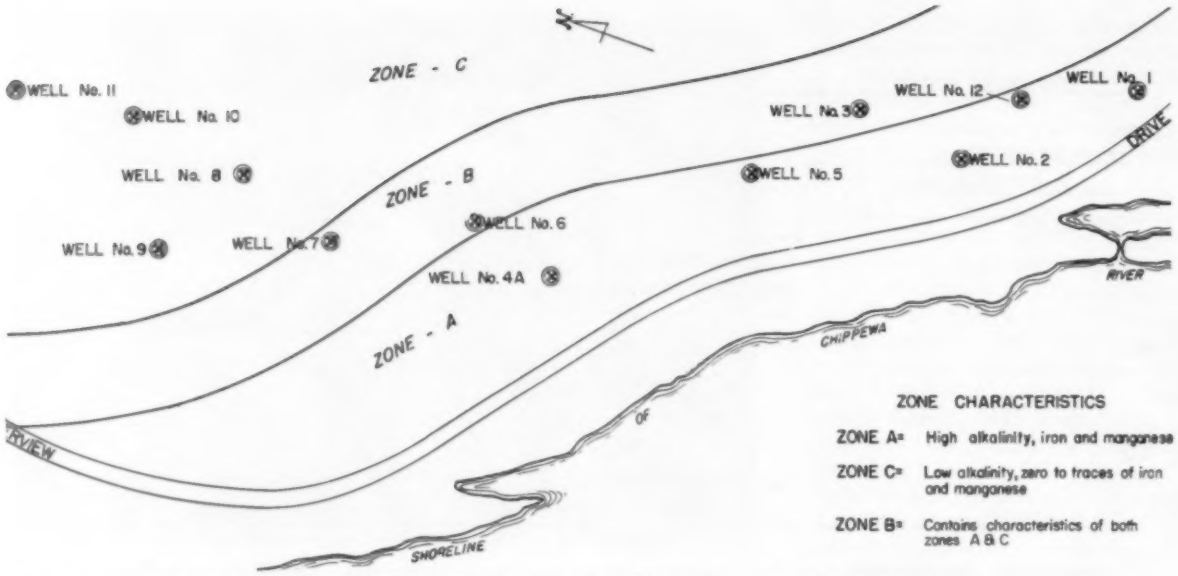


FIG. 6—Analysis of well waters indicate three separate zones based on chemical characteristics.

According to the characteristics of the water in the various zones, the water quality can be predicted, with some degree of accuracy, in zones A and C. Zone B appears to produce a water of unpredictable quality, and it may be advisable to avoid locating wells in this area, since an extremely low alkalinity water containing iron and manganese can not be used in the split treatment process.

Future of Split Treatment

On the basis of the information compiled and evaluated so far, it would indeed be difficult to positively predict how long the split treatment process may be used, because it is directly dependent upon the iron and manganese free wells remaining as they are. Based on operations over the past 15 years, there has been no tendency for iron and manganese to develop in these wells. Our greatest concern is the location of new wells plus a carefully prepared plan of water withdrawal to prevent a change in the natural underground flows which might affect the water characteristics of the various wells.

It is highly doubtful that any change would be of an overnight nature, but rather a gradual transition that would give us ample warning to altar our pumping rates, or even temporarily abandon the use of some wells. During the peak withdrawal periods, it will be advisable to make frequent well analyses so that characteristic changes of the water can be followed closely and thereby prevent overpumpage in certain areas.

Much research remains to be accomplished before relatively accurate predictions can be made. Among some of these contemplated study areas are:

A. The construction of a granite contour map.
B. The relationship of well characteristics to discharge and recharge of the water table.
C. The construction of a contour map of the water table.
D. An analysis of private wells adjacent to the well field.

Since the advent of the split treatment process, there has been no basic change in well characteristics. Providing we do not have an unusually high demand for water, such as a new industry that would require an additional several million gallons of water daily, or an unusually hot, dry summer which would tax our well capacities, the split treatment process will handle the present withdrawal rate very successfully for probably an indefinite period. The existing wells will deliver a combined rate of approximately 25 mgd.

Table 2

Location and Use of Wells

Well No.	Alkalinity PPM	Iron PPM	Manganese PPM	Location Zone	Use Raw	Use Treated
1	82	0.14	2.64	A		X
2	80	0.20	4.70	A		X
*3	44	0	0	B		X
4	90	2.50	4.56	A		X
5	73	0.10	2.94	A		X
6	40	0	0	B	X or	X
7	64	0	Trace	B	X	
8	56	0	0	C	X	
9	56	0	0	C	X	
10	42	0	0	C	X	
11	34	0	0	C	X	
12	70	Trace	1.62	A		X

* Plans are being considered whereby we can pipe No. 3 well so that it can be used either through the treatment basin or through the bypass basin.

Summary

Saving's have been calculated to be more than $40,000 a year by utilizing the split treatment process. This figure includes savings in chemical purchases, the greatest saving being carbon dioxide, plus the savings in operation and maintenance of feeding equipment that would normally be used if the total water produced was treated.

TO HELP relieve a critical water storage situation the Las Vegas Valley Water District constructed an

ALUMINUM COVERED RESERVOIR

which provided an economical solution to its problem

by W. C. RENSHAW, Chief Engineer & Gen'l Manager, Las Vegas Valley Water District, Las Vegas, Nev.

RESUME: This article describes briefly one novel answer to the widespread problem of expanding facilities with a limited budget to meet a rapid consumer growth.

■ AN ECONOMICAL solution to its distribution storage problem was found by the Las Vegas Valley Water District in the 30,000,000 gallon aluminum covered reservoir constructed as part of a major rehabilitation and expansion program completed in 1957. Prior to construction of this reservoir, the District had a little over 4,000,000 gallons storage as compared with a peak consumption of 27,000,000 mgd.

District Formed

The District was formed in 1948 to relieve a critical water supply situation which had developed in the Las Vegas area. Water use was substantially in excess of the natural replenishment of the artesian ground water basin which formed the entire supply. With the proceeds of an $8,700,000 bond issue voted in 1953, the District purchased the facilities of the private company supplying the City of Las Vegas, taking them over on July 1, 1954. The construction program, designed both to provide an additional water supply from Lake Mead and to overcome serious deficiencies in the distribution system resulting from a rapid population growth, began soon thereafter.

Since the size of the bond issue had been limited by the bonding capacity of the District, and rising costs had rendered the funds available barely sufficient to carry out essential features of the program, it was of more than usual importance that construction costs be kept as low as possible, consistent with dependability and reasonable life expectancy.

THE TAPER of the steel beams shows clearly in this view from south basin showing partly completed roof on the north basin.

Reservoir Described

The reservoir is formed by compacted earth embankments to a height of 15.5 feet above the low point of the floor, surmounted by 8 foot vertical concrete walls. The high water line is 1.5 feet below the top of the wall. The embankment on the outside is brought up to 3 feet below the top of the wall. A similar embankment and wall divides the reservoir into two basins.

Both interior and exterior slopes are 2 to 1 and the crest width outside of the wall is 18 feet. A paved roadway with a concrete curb and gutter is provided around the crest, access being by means of ramps at two of the corners.

An unusual feature of the construction is that the reservoir is entirely above the original ground surface instead of being partly in cut. This was done to avoid cutting through a layer of hardpan or soft rock, known locally as caliche, which lay immediately below the surface and under which ground water is frequently encountered. The material for the embankment was borrowed from surrounding property owned by the District.

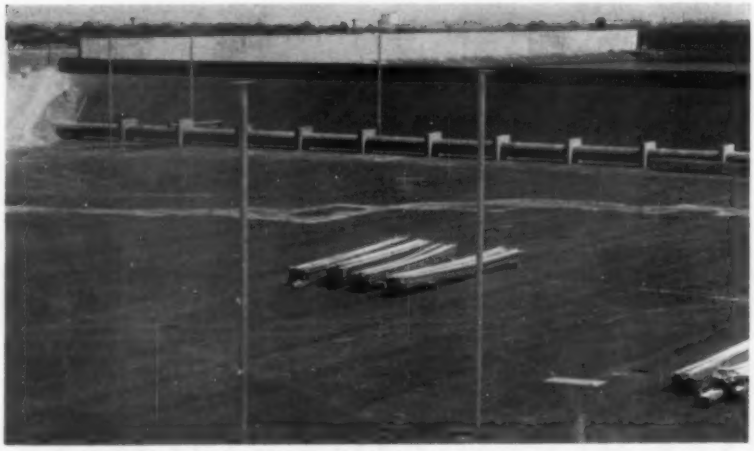
As tests of the embankment material had shown it to have a high degree of impermeability, it was not necessary to provide an impervious lining. 3 inches of asphalt concrete was placed on the floor and the inner embankment slopes, the specified mix being porous to facilitate drainage and avoid hydrostatic pressure under the lining when the reservoir was drawn down. The original design called for porous concrete (a lean mix of pea gravel and cement) under the asphalt on the slopes. This had been used successfully in other localities, but it was found that, with the very high temperatures and low humidity prevalent in the Las Vegas area, the thin coating of cement mortar on the gravel particles would dry out before the material could be placed, preventing adhesion. Compacted pit run gravel was, therefore, substituted.

Roof Construction

The roof of the reservoir is composed of corrugated aluminum sheets supported on galvanized structural steel purlins which in turn rest on galvanized tapered steel beams. It is pitched ½ inch in 12 inches to a ridge with a continuous screened ventilator. Screened openings are also provided between the roof and the wall along two sides. Columns are 6 inch standard steel pipe except for short columns on the slopes, which are 4 inch or 5 inch. Maximum column length is 30 ft 7 in. Bracing in both horizontal and vertical planes consists of diagonal steel rods with turnbuckles.

Columns and bracing, which will be largely submerged, were given four coats of a synthetic resin paint. The beams and purlins were galvanized after fabrication and no painting was required. Galvanizing of these members was not called for in the specifications due to the possibility of warping during the galvanizing process, but was permitted at the request of the Contractor and at his risk. Warping occurred, requiring considerable work in the field to straighten the affected members. The need for proper guying of the steel work during erection was emphasized by collapse of partly erected sections on two occasions due to high winds. Damage consisted principally of bent and twisted purlins.

In order to insulate the aluminum sheets from the galvanized purlins, neoprene washers were used under the heads of the straw nails and the tops of the purlins were painted with an aluminum imgregnated bituminous paint.



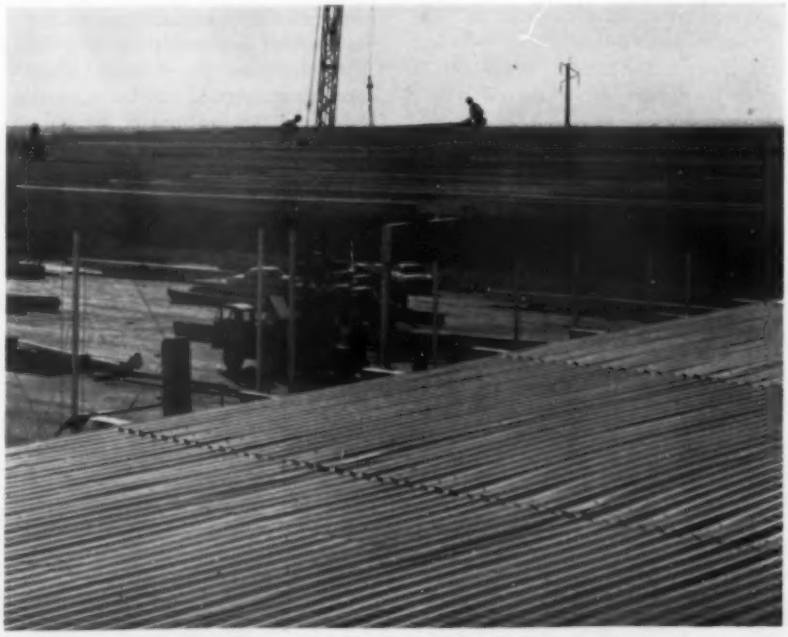
SOME STEEL PIPE COLUMNS set and the inlet line are in place in the north basin while the south basin is in partial use.

Costs

The cost of the reservoir was as follows:

Contract costs exclusive of roof	$356,095.00
Contract costs—roof	264,782.00
Total Contract Cost	$620,877.00
Engineering, inspection and Miscellaneous costs	$ 71,033.00
Total Cost	$691,910.00

The unit cost per million gallons of storage capacity was $23,000.000. The roof, with an area of 229,500 square feet, or about 5¼ acres, cost $1.29 per square foot.



ROOF CONSTRUCTION proceeds with the placing of corrugated aluminum.

Meeting in Dallas included many papers and reports on . . .

Water Purification, Distribution, and Resources

EDITOR'S NOTE: In the past two issues we have carried reports on papers presented at the 78th annual AWWA Conference. In this report, we conclude the report of that meeting with reviews and abstracts of other papers presented at the meeting.

Water Purification*

■ ONE OF THE SESSIONS of the Water Purification Division consisted of three panel discussions. The session was presided over by Paul D. Haney, Chairman of the Division.

■ VALUE AND LIMITATIONS OF CHLORINE RESIDUALS IN DISTRIBUTION SYSTEMS—PANEL DISCUSSION —H. A. Faber, Research Co-ordinator, Engineering Resources Program, Division of Sanitary Engineering Services, U. S. Public Health Service, Washington, D. C., Moderator; panel members J. R. Baylis, Engineer, Water Purification, Chicago, Ill.; M. P. Crabill, Vice Pres. of Operations, Indianapolis Water Company, Indianapolis, Ind.; A. E. Griffin, Technical Consultant, Wallace and Tiernan, Bellville, N. J. and E. J. Umbenhauer, Supt. Municipal Water and Sewer System, El Paso, Texas.

J. R. Baylis discussed the increase in chlorine consumption of a large city which in 1920 used 3 to 6 lb per mil gal of chlorine now uses up to 18 lb per mil gal. In the 1930's chloramines were used to cover the distribution system as a disinfectant.

At Chicago a free chlorine residual is desirable which will persist throughout the distribution system. This is required to conform to USPHS requirements for provision to common carriers. Slides indicated the amperometric titrator and chlorine residual recorder. Also illustrated were emergency chlorination apparatus and tubercles from distribution system piping which studies have shown may have been caused by residual chlorine.

H. A. Faber

J. R. Baylis

Panel Discussion of Chlorine Residuals

M. R. Crabill reported that Indianapolis favors a free chlorine residual throughout the distribution system. This is difficult through September, however in June, it is possible to obtain 0.3 mg/L to the extremities of the system. An increase in temperature causes loss of residual out in the distribution system which he believes is understandable.

The water analyses at Indianapolis indicate no contamination when chlorine is present. When no residual exists, bacteriological plates indicate high colony count and some coliforms are present. In order to overcome this potential hazard a hypochlorinating station is used during late summer months.

Free chlorination has three hours contact in the water treatment plant at normal rates, but studies indicate this is not a guaranty against gross contamination in the distribution system. The presence of chlorine is valuable as an indicator of potential trouble in the system if good records are kept.

E. J. Umbenhauer pointed out that the assignment of a Water Department is to produce a safe water, reduce complaints and to do so as economically as feasible. El Paso has 37,000 water service connections, and a 900 ft elevation spanning 10 different pressure systems and 17 covered reservoirs.

Chlorine was first applied in El Paso prior to 1940 and some problems in the distribution system occurred. Chloramines were used to great extent and 0.5 mg/L would not carry to the extremities of the system. Free residual chlorine (0.75 mg/L) carries through in most cases to the end of the system, however some additional dosage was needed. At one period when residual was increased to 2 mg/L at the treatment plant, 1.5 mg/L were carried to the ends of the system. This resulted in some complaints, mostly from commercial users and newcomers. This can usually be traced to paper cups or ice provided by vendors.

A. E. Griffin reported the results of a survey in which 114 questionnaires were sent out and 87 replies were received. Data covered points of chlorine addition, pre and post chlorination, (one plant reported no chlorine was used). Thirty-eight percent of the replies indicated use of chloramine process which was used by 75 percent of the softening plants responding. Ammonia is applied as a post-treatment in 26 percent of the treatment plants using this process.

With regard to analytical methods, the ortho-tolidine colimetric procedure was used by 42, the amperometric-titrator were used by 20, orthotolidine and the amperometric-titrator

*Two of the sessions of the Purification Division are reported by Virgil Langworthy, Chief Applications Engineer, Omega Machine Co., Providence, R. I. and one session by Paul D. Haney, Sanitary Engineer, Black & Veatch, Cons. Engrs., Kansas City, Mo., and a Contributing Editor to *Water & Sewage Works*.

were used by 19 and one reported using the starch iodide titration.

Ranges of dosage applied included a maximum of 25 mg/L as pre-chlorination with a minimum of 0.2 mg/L reported. Maximum post-chlorination dose reported was 12 mg/L with a minimum of 0.2 mg/L.

In answer to the question, "What are the results of chlorination?" those responding to the survey questionnaires reported that it keeps mains free of slime, assists in the control of pH and that temperature increases about 58° to 60° F., rendered it difficult to maintain a residual of any kind in the distribution system. There were comments that chlorination both

M. P. Crabill

A. E. Griffin

Chlorine Residual Panel

decreased and increased the taste and odor problem.

■ MONITORING STREAM WATER QUALITY — PANEL DISCUSSION — H. O. Hartung, Vice President and Manager of Production, St. Louis County Water Company, St. Louis, Mo., Moderator and panel members E. J. Cleary, Exec. Dir. and Chief Engr., ORSANCO, Cincinnati, Ohio (sub. D. A. Robinson, ORSANCO Staff); R. C. Palange, Assistant Chief Water Supply and Pollution Program; Robert A. Taft, Sanitary Engineering Center, Cincinnati, Ohio and Lee Streicher, Chief Chemist, M. W. D. of Southern California, La-Verne, California.

In introducing this discussion H. O. Hartung pointed out that the water works profession has a responsibility in the water treatment program which cannot be delegated. The objectives of the stream water quality monitoring program was to

1) learn the characteristics of water supplies,

2) describe the problems involved in water treatment,

3) assess the significance of water pollutants,

4) pinpoint sources of pollution,

5) detect pollutional spills,

6) alert downstream users about spills and pollutants,

7) provide background information on supply characteristics, and

8) procure data for supplies.

Lee Streicher said that the Metropolitan District of Southern California has a 250-mile raw water transmission line on which there are no sewage or industrial wastes. However, there are reservoirs along the way which blend various sources of water en route to the treatment plant at LaVerne. Since June of 1951, chemical analyses have been performed on water from Lake Havasu and original increase in dissolved solids and total hardness has been tapering off since 1953. A drought in 1953 caused the increase noted.

Samples are also taken from pumping stations and an aliquot is collected at the LaVerne plant for monthly analysis. Biological monitoring is accomplished twice a month at Lake Havasu and twice a month at each pumping station, two samples per week are analyzed from eight points at Lake Matthews, thirty-five miles from LaVerne. Pinpoint and spot treatment has kept pace with biological contamination with no general treatment of Lake Matthews required since 1951.

Radiological monitoring has consisted of monitoring of soil samples in January 1951, 1952, 1953 and 1955 from an area north of Lake Meade. Radiological monitoring is accomplished monthly on samples from lakes on the raw water transmission system and of the plant influent and effluent. These samples have to date been below the maximum permissible level.

R. C. Palange reported U. S. Public Health Services activity in the collection of obtaining basic data. Fifty water sampling stations, most of which are in operation now, collect weekly radiological and coliform bacteria information. The membrane filter is used for the coliform determinations. Monthly carbon extraction determinations and temperature, biological oxygen demand, chemical oxygen demand, pH, total hardness, color, turbidity, and Plankton reports are made.

Where sampling stations are at water treatment plants, in most cases these plants are doing the chemical analyses. Other stations forward samples to the laboratories at Cincinnati for analysis. The program started with ten stations across the country as a pilot network which operated for six months. As of April 1, 1958 forty-four stations were in operation with an additional six stations to be in operation soon. The predominant location of sampling points are at existing water plant intakes. The data will be published annually so that all may benefit from the program.

D. A. Robinson read remarks which had been prepared by E. J. Cleary and discussed "Imagineer-

H. O. Hartung

Lee Streicher

Monitoring Stream Quality

ing." An idealized automated analytical and recording system to process data from river samples was imagined. Long rivers with many tributaries and thousands of pollutional sources and many water supplies would be involved in this type water system. This system would alert their treatment processes accordingly. Mr. Cleary believes that sporadic surveys do not satisfactorily approach a solution to the problem of understanding water supply conditions. He pointed out that ORSANCO seeks a self-operating system which may be used to monitor stream water quality. Some methods and devices are being tested presently.

H. O. Hartung reported that the Co-operative Pollution Monitoring Committee has been in operation on the Missouri River since 1957. Basic analytical method has been the use of the carbon filter chloroform extraction technique. This method assists in the reporting of unusual taste and odor problems. In one case, Mallinchrodt Chemical Works reports the analysis of wastes discharged to the Missouri River at its Atomic Energy Commission Contract Plant.

■ THE EMERGENCY RE-USE OF WATER AT CHANUTE, KAN.—In two parts.

Part I was presented by D. F. Metzler, Chief Engineer, State Board of Health, Topeka, Kan., and was prepared jointly by Mr. Metzler, R. L. Culp, Chief Water Supply Section, State Board of Health, Topeka, Kan., and H. A. Stoltenberg, Principal Chemist, Division of Sanitation, State Board of Health, Topeka, Kan.

Part II was presented by R. L. Woodward, Chief, Water Supply, U. S. Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Collaborating with Mr. Woodward were S. L. Change, Senior Surgeon, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, N. A. Clarke, Senior Scientist, Robert A. Taft Engineering Center, Cincinnati, Ohio, F. M. Middleton, Scientist-Director, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. C. M. Palmer, Resident Biologist, U. S. Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, and vice, Robert A. Taft Sanitary Engi- G. Walton, U. S. Public Health Se neering Center, Cincinnati, Ohio.

This paper presented a complete report on the 1956-57 emeregncy situation at Chanute, Kan., where sewage treatment plant effluent was recirculated to the water treatment plant. The period included October 1956, to March 1957, and the report covers treatment methods used, some of the problems which arose and the water quality studies which were made during the period of water recirculation. No adverse affects on the health of the people were noted but much of the population used other sources of drinking water because of the various objectionable characteristics of the public supply.

A discussion of the paper was presented by C. H. Connell, Professor of Sanitation, Department of Preventative Medicine and Public Health, University of Texas, Medical Branch, Galveston, Texas. It was noted in the discussion that under recirculation conditions as practiced at Chanute, the level of nitrates should be carefully watched as protection against blue-baby incidents during the period of water re-use. Indirect factors such as purchase of water from questionable sources should be carefully controlled. Professor Connell believed that the practice of free residual chlorination should have been carried on for a short time during the re-cycling period might have controlled some of the reported bacterial increases.

Major C. Hager, General Water Superintendent, City of Sioux Falls, So. Dak., raised the point that clay or coagulant aids might have assisted in removing the algae which clearly interfered with filter runs during the re-cycling period. Mr. Culp reported that no coagulant aids were used to attempt in improving the coagulation process in the water treatment plant.

A. P. Black

F. A. Eidsness

Water Coagulation Studies

■ EFFECT OF SYNTHETIC DETERGENTS UPON WATER SOFTENING ECONOMICS by William W. Aultman, Vice Pres., James M. Montgomery, Cons. Engrs., Pasadena, Calif.

Detergents are cleansing agents; soap, which is a sodium or potassium salt of a fatty acid, is one of the best known detergents. Unfortunately soap is precipitated by the hardness-producing constituents, principally calcium and magnesium, in water. In the past, several authorities have shown that, in many communities, soap savings resulting from municipal water softening would more than offset the cost of municipal softening.

The newer cleansing materials termed "synthetic detergents" or "syndets" are complex chemical compounds that are often made from petroleum derivatives. A major item stressed in the publicity for syndets has been satisfactory performance in hard or soft water. This has led to the belief on the part of many that water softening is no longer necessary. Actually this is not true; syndets have provided only a partial solution to the hard water problem. While they are not precipitated by hardness, in order to obtain acceptable cleansing action it has been found necessary to add phosphate sequestering agents to the syndets. The higher the hardness of the water the more phosphate required.

An investigation by the author which included (a) a survey of the technical literature (b) correspondence with manufacturing and research chemists from the detergent industry, and private and governmental research technicians (c) personal interviews, has shown conclusively that water hardness *does* have an important effect on the efficiency of the syndets used in the home.

The best data currently available pertaining to the relative amounts of syndets and soaps required in hard and soft waters were obtained from a study conducted in 1955 for the Dow Chemical Co. and the Woman's Home Companion. A family of five was selected and data were collected during four six-week periods as follows:

1. First 6-week period using hard water (360-410 mg/L) and syndets
2. Second 6-week period using hard water (360-410 mg/L) and soap
3. Third 6-week period using soft water (0-10 mg/L) and syndets
4. Fourth 6-week period using soft water (0-10 mg/L) and soap.

The results of this study showed that more soap and syndets were needed in hard than in soft water; however, the relative quantity of syndet required in hard water vs. soft water was proportionately not so great as the quantity of soap required. The annual difference in the cost of cleansing agents when using hard vs. soft water was $33.66 for syndets and $51.22 for soap.

Many other intangible benefits are associated with the use of soft water. These include water-heater fuel savings, lower plumbing-repair costs and less wear on fabrics and utensils. Food cooked in soft water retains its natural color and appearance; coffee and tea can be brewed more economically. Soft water reduces the possibility for skin drying and irritation. Bathtub "ring" is reduced; shaving blades last longer. The extent to which soft water benefits are realized will depend upon the actual hardness remaining in the water after treatment.

Maximum benefits will be achieved when water approaching zero hardness is used. While municipally soft-

ened water generally ranges from 85 to 100 mg/L, water of this hardness is comparatively many times better than the 300-500 mg/L hardness of unsoftened natural water.

The cost of municipal softening, including amortization and replacement reserve, may be expected to range from about 3¢ to 7¢ per 1000 gallons. Assuming a 30 mgd treatment plant and hardness reduced from 380 to 100 mg/L, the average net saving to a family of 3.5 persons will range from approximately $24.-00 to $40.00 per year. For a city of 35,000 persons, savings might be as much as $300,000 to $400,000 per year. The saving realized in a specific situation will depend upon the relative amounts of syndet to soap used and upon the per-capita consumption of water. The author concludes that from an analysis of the available facts "the advent of synthetic detergents has not changed the economic desirability of water softening."

In his discussion of this paper, **T. E. Larson,** Illinois State Water Survey, stated that he was in essentially complete agreement with the author's conclusions and that municipal softening is the best and cheapest method of hardness reduction. Larson did point out that the basic data on soap or syndet savings are statistically inadequate and that there is a great need for better data than are now available.

In his closing remarks Aultman emphasized the value of a soft water supply to industrial consumers.

■ Chemistry of Chlorine Dioxide by M. L. Granstrom, Assoc. Prof., San. Engr., Univ. of No. Car., Chapel Hill, N. C.

The author introduced the subject with a discussion of the results of a questionnaire sent to 150 water works believed to be using chlorine dioxide treatment. There were 75 replies which were analyzed as follows:

Nineteen of 75 plants indicated that chlorine dioxide had never been used or that its use had been discontinued. Reasons for discontinuance included unsatisfactory performance, lack of need, and high cost.

Thirty-four plants used chlorine dioxide the entire year and the other 22 used it intermittently.

Reasons for its use were listed as follows:

a. 52 plants had taste and odor problems; of these, 37 were phenolic in nature
b. 3 plants had iron and manganese problems
c. 7 plants had algal problems (Only 15 operators mentioned disinfection in connection with the use of chlorine dioxide)

Points of application

a. Raw water: 15 plants
b. Following coagulation: 3 plants
c. Following settling: 6 plants
d. Following filtration: 35 plants

In 41 plants chlorine is added separately from chlorine dioxide; 34, before chlorine dioxide and 7, after.

The quantity of sodium chlorite (78 percent) used in the generation of chlorine dioxide varied from 0.3 to to 10 lb per mil gal. Ratios of chlorine to sodium chlorite varied from 10:1 to 1:1 on a pounds-per-million-gallons basis.

R. L. Culp
Water Reuse

E. W. Whitlock
Screen Backwashing

The pH values of the sodium chlorite solution entering the generator generally varied from 8.7 to 12.5. The pH of the chlorine solution fed to the generator ranged generally from 1.2 to 4.1. The pH of the generator effluent varied from 1.2 to 10.4. All but two values were 4.0 or less.

The contact time in the generator between chlorine and chlorite varied from 10 seconds to 30 minutes; most contact periods were less than 5 minutes.

Analytical methods used in connection with chlorine dioxide treatment were:

29 plants used the ortho-tolidine test

1 plant used the tyrosine method

4 plants used the amperometric method

2 plants used the starch-iodide method

20 plants did not make analytical measurements

(Eleven operators expressed dissatisfaction with existing analytical procedures.)

In general, the questionnaires indicated that (1) chlorine dioxide is usually satisfactory where problems of phenols exist, (2) many operators are not satisfied with analytical procedures, (3) many operators are not fully aware of optimum conditions for chlorine dioxide generation.

The author studied the chlorine-sodium chlorite reaction for chlorine dioxide generation by spectrophometric methods. Experimental results indicated that with a molar ration of chlorine to chlorite of 1.0 to 2.0 the end products did not include either chlorine or chlorite, only chlorine dioxide.

Excess chlorine in the reaction solution increased the speed of reaction; decrease in pH also resulted in higher reaction velocity. Yield was influenced by pH. If the pH value is too high or too low, yield of chlorine dioxide may be adversely affected. In operating practice a pH of 4.0 or less is common.

In analytical work it is important to distinguish between chlorine dioxide which is a good disinfectant and the chlorine ion which is a poor disinfectant.

The mechanism of phenol destruction by chlorine dioxide is not well understood and will be the subject of a future investigation.

The answer to the question as to the best points of application of chlorine and chlorine dioxide cannot be answered except by analyses at each water treatment plant.

■ Electrophoretic Studies of Water Coagulation by Janet B. Pilipovich, A. P. Black, F. A. Eidsness, and T. W. Stearns, Univ of Florida, Gainesville, Fla.

In his introductory remarks, Dr. Black emphasized the fundamental importance of colloid chemistry to the subject of coagulation. He further stated that while the techniques and methods of alum coagulation are well advanced, the fundamental mechanisms are not completely understood. Two important factors associated with the stability of colloidal suspensions are the "zeta potential," sometimes termed the "charge," and "hydration." Coagulation occurs when the degree of hydration or the zeta potential are insufficient to maintain a stable suspension. Zeta potential

and hydration decrease as the isoelectric point is approached.

Theories of coagulation of turbid waters by alum have emphasized the importance of (1) neutralization of the negative zeta potential of the colloid by the high positive charge on the aluminum ion and (2) the ion-exchange capacity of clay suspensions. These theories were developed by Black and Langelier, respectively. On the other hand experimental work conducted by Mattson led him to conclude that the hydrolysis products of alum are the effective agents in coagulation. His data also indicated that coagulation takes place well before the isoelectric point is reached. While

W. W. Aultman **T. E. Larson**
Syndets and Water Softening

there is not complete agreement between the theories proposed by Black and Langelier, there is agreement regarding the importance of the aluminum ion. These theories differ markedly from that proposed by Mattson who attributes the coagulating power of alum to its hydrolysis products.

Electrophoresis, formerly called cataphoresis, is defined as the movement of particles in an electrical field, and is a potentially valuable tool for coagulation studies. Black and associates conducted electrophoretic and other studies of alum coagulation of standard clay suspensions. The investigation included the following subjects:

1. Effect of base-exchange capacity of clay on amount of alum needed for good coagulation.
2. Type of curve obtained with clays of varying base-exchange capacity by plotting alum dosage against final turbidity.
3. Experiments designed to determine which is the most effective in coagulation—the aluminum ion or the alum hydrolysis products.
4. Relationship between the amount of alum necessary for good coagulation and the amount needed to reach the isoelectric point.
5. Experiments designed to test the theory that a certain amount of binder alum is necessary for good coagulation.

The experimental work led to the following conclusion:

1. With increased alum dosage, the zeta potential on the clay suspension decreases sharply until shortly before the isoelectric point. Further increase in dosage produces very slight further decrease in zeta potential.
2. Coagulation of clay suspensions occurs well before the isoelectric point.
3. With low base-exchange clays there is no apparent relationship between clay suspension concentration needed for first floc formation; for high base-exchange clays, there appears to be a relationship.
4. Low base-exchange clays require considerably less alum than the high exchange variety, unless the latter are very dilute.
5. No quantitative relationship appears to exist between the base-exchange capacity of the suspension and the isoelectric point. Alum dosage to reach the isoelectric point is higher for high base-exchange clays than for low, but no direct or constant relationship exists.
6. Results from the clay suspensions studied indicate that the hydrolysis products of alum are stronger coagulating agents than the trivalent aluminum ions.

■ USE OF HYDRAULICALLY BACKWASHED SCREENS FOR SURFACE WATER by Ernest D. Whitlock and Robert D. Mitchell, Partners, Malcolm Pirnie Associates, Cons. Engrs., New York, N. Y.

This discussion described the use of hydraulically-cleaned, stationary screens at water works intakes. An early installation was the one made in 1935 for an industrial water supply. In this instance, the stationary screen, after clogging with debris, was backwashed using line pressure; backwashing was accomplished by the manipulation of valves.

At another installation, vertically-mounted well screens were used with appropriate arrangements for backwashing. All installations have proven highly successful.

Considerable time and labor are required to clean screens located in deep intake structures. Hydraulic cleaning, on the other hand, is quick and comparatively easy. Varieties of installations including multiple screens are possible.

■ MANGANESE PROBLEMS by A. E. Griffin, Division of Technical Services, Wallace & Tiernan, Inc., Bellville, New Jersey.

Manganese problems are not confined to any geographical area nor are they always of a continuing nature. Manganese defies easy detection and the lack of a sensitive test for manganese further complicates the problem of treatment. With the exception of plants which provide

V. J. Calise **R. L. Derby**
Iron & Manganese Membrane Filters

lime soda softening, manganese passes easily through the normal filter plant process.

Mr. Griffin showed samples containing manganese in a jelly-like form. Particularly troublesome are compounds containing manganese complexes. In general, oxidation reactions involving chlorine, chlorine dioxide and potassium permanganate have been successful in removing manganese to a degree. The reaction involving potassium permanganate in the removal of manganese from the water supply is not clear.

■ MANGANESE RESEARCH by Floyd I. Brownley, Jr., Clemson College, Clemson, So. Car.

This report was presented by Martin Flentje, Res. Engr., American Water Works Service Co., Philadelphia, Pa.

Present research is aimed toward detection of the form in which manganese is present in water supplies and to devise a suitable test for differentiating between manganous forms. Thus far, research has indicated that the polarograph and the chemical methods are not sensitive enough.

Analytical methods involving pyro-catechol violet precipitate, bio-assay and redox potential may shed light on the ultimate analytical method.

Committee Report 2680P points out that the standard (0.3 mg/L) may perhaps be too high for general application. Manganese and iron together are worse than either mineral existing alone, and control removal of these pollutants is not easy.

■ IRON AND MANGANESE REDUCTION by E. J. Taggart, V. J. Calise and J. Levandowsky of Graver Water Conditioning Co., New York, N. Y.

Ground supplies usually provide some degree of manganese content and may be localized geographically. Objections to manganese containing potable water were reviewed. Industrial process objections are: water containing manganese interferes with the finished product, staining in municipal and domestic laundries and plumbing fixtures. Manganese occurs as organic and in-organic complexes.

For the two compounds, iron oxidizes faster; therefore, is more easily removed or reduced to a tolerable minimum. Under certain conditions, iron and manganese may be sequestered in solution by some polyphosphate compounds. Ion exchange may be used to remove up to 3 mg/L manganese and softening and coagulation plants are efficient means of removing these contaminants.

Among the comments made on this subject following the paper was the fact that some of the TVA lakes contain 20 mg/L of manganese in the bottom and up to 2mg/L in lake effluent. Also included was the comment that crenothrix may precipitate manganese as part of its metabolic activity.

■ PLANNED RESEARCH ON FILTER WASHING by W. W. Aultman, James M. Montgomery, Consulting Engineers, Pasadena, Calif.

Mr. Aultman delivered this report for Professor Jack McKee. The report stated that fundamental relationships would be studied involving the nature of turbid and laminar flows, the effect of velocity and viscosity of the water on filtration, and shear as a function in filter backwashing. The study of power inputs required for a surface wash by water, air scouring and mechanical raking would be included.

It is proposed that lucite tubes containing various filtration media and various fluids will be used as analytical tools. Head loss will be measured at various points in the suspended medium during backwash. The time to remove clogging materials (alum, silicates, etc.) will also be determined. The research program has been approved; however, no funds have been available for fiscal 1958. It is hoped that funds may be made available during fiscal 1959 to carry on this work.

■ SOME STUDIES ON FILTER WASHING by R. E. Hebert, Pres., Filtration Equipment Corp., Rochester, N. Y. and J. R. Bayliss, Engineer of Water Purification, Chicago, Ill.

J. C. Vaughn
Syndets

R. Eliassen
Water Conditioning Devices

Mr. Hebert's paper considered the underdrain system and its affect on the backwash cycle of rapid sand filters. He divided the backwash operation into three separate areas: (1) from the bottom of the filter through the underdrain; (2) the area including the small gravel and sand; and (3) the area from the level of the expanded sand to the level of the overflow into washwater troughs. Each of these areas was then discussed in detail and slides were used to illustrate headlosses at various backwash rates.

Mr. Hebert concluded that continued research on filter backwashing should be promoted. Two factors, should be considered throughout the research program. These are methods for the design of new filter plants as well as studies which would raise the operating efficiency for thousands of rapid sand filters now in service. A moving picture illustrating a section through a 1 square foot model was used to illustrate water flow paths during backwash.

Mr. Bayliss discussed gravel movement caused by filter backwashing. The gravel level in South District Filtration Plant filters has become uneven. The surface wash system has been effective to prevent clogging but does not prevent gravel mounding. It was indicated that fine gravel movement is caused by jet action at the junction of gravel and sand in the filter proper. A series of tests was conducted prior to starting work on repairing filter beds. The tests were made with a 6-inch clear plastic pipe and a glass-sided filter 3-feet square. Extended backwash tests were made from beds properly constructed in the experimental unit and photographs were made at various sand expansion rates. The report covers in considerable detail the effect of sand motion on various sections of the filter bed. Mr. Bayliss indicates that the trend towards large size filter units may be detrimental. As published, the paper will include twenty-nine illustrations to substantiate the data reported.

■ MEMBRANE FILTERS — TASK GROUP REPORT, presented by R. L. Derby, Principal Sanitary Engineer, Los Angeles, Calif. This report of membrane filter media pointed out that the method is new since the tenth edition of Standard Methods was published. The Task Group has checked journals for membrane filter articles, prepared brief abstracts of articles not pertinent and made a thorough abstract of articles more pertinent to this technique. The abstracts are to be typed out and distributed to members of the task group by August, 1958. The report includes a review of the bibliography on the subject.

■ ANALYTICAL METHODS FOR DETERGENTS by J. C. Vaughn, South District Filtration Plant, Chicago, Ill.

A Task Group decided to seek a sponsored project on this subject. The National Association of Soap and Glycerine Manufacturers have assisted in the program. The University of Illinois applied for a grant from the National Institutes of Health to participate in this research program. An amperometric titrator has been made available for use by the research agency. A guide has been written outlining the methylene blue procedure for detergent determination. The referee method uses the infra-red spectrometer.

■ CHLORINE STANDARDS AND RESEARCH by L. L. Hedgepeth, Technical Consultant, American Cyanamid Co., New York; report presented by H. A. Faber, Research Co-ordinator, U. S. Public Health Service, Washington, D. C.

The report stated that the February issue of Journal American Water Works Association contains the tentative standard specification for liquid chlorine. Because no easily performed, precise analytical procedure is available, research is needed to provide a realistic answer to liquid chlorine analysis. A research grant along these lines has been approved for research to be continued at Purdue University. This program will start in June, 1958.

■ WATER CONDITIONING DEVICES by Rolf Eliasson, R. T. Skrinde and W. B. Davis, all of Massachusetts Institute of Technology, Cambridge, Massachusetts.

This report was presented by Dr. Eliasson and included results of studying the Cepi and Packard devices reputed to be helpful in overcoming some of the objectionable qualities of potable water namely, hardness, scale formation and corrosion.

According to the report the devices are obviously a hoax when compared on a scientific basis with known scientific parameters. The advertising literature contains claims which cannot be substantiated using accepted analytical methods. Tests at Cambridge Water Treatment Plant and M.I.T. Laboratories show the units to have no affect on total hardness, reduction of scale formation, no scale dissolving ability or corrosion prevention activity. No electro-chemical changes could be detected in water treated by either of the units mentioned above.

The investigators conclude that the water treatment devices do not alter the behavior of the water, its hardness or scale forming ability. The group asks that information be used in public relations activities and disseminated as widely as possible.

■ STANDARD SPECIFICATIONS — a Task Group Report—C. A. Black, President, Black Laboratories, Gainesville, Fla., reported that standard specifications for chlorine and copper sulfate have been completed.

Water Distribution*

■ WATER FROM PLANS TO PLENTY —a motion picture by the Indianapolis Water Co.

One Water Works Distribution Division Session was opened with the showing of an excellent movie of the planning and improvements undertaken by the Indianapolis Water Company. The movie was a history of the demand and supply of water to the Indianapolis area.

An interesting point of the film was the extensive use of raw water reservoirs for recreational use. The lakes are used for swimming, boating, and fishing. Boat and sailing clubs provide excellent recreation during the summer months.

Uel Stephens
Reservoir
Evaporation

M. P. Hatcher
Missouri
River

No major problems have occurred by virtue of this recreational use, due to the complete policing program of the Water Company and the local Fish Commission. It appears that the public in the Indianapolis area appreciates the advantage afforded them, and respect the rights of the private property owner.

■ THE VALUE OF CATHODIC PROTECTION by George B. McComb, Consultant, St. Louis, Mo.

Privately owned oil and gas line companies usually use cathodic protection for the safety of their buried lines. With cathodic protection of steel water lines lower maintenance costs result, and the lines may have longer life—equal to any other type of water pipes.

In order to have steel water lines successful, the proper selection of coatings and a technical evaluation of local conditions for stray currents is necessary. The cause of failure and corrosion of steel water lines may be chemical changes due to rust, dissimilar metals or dissimilar soils, inducing currents. A check of interference with other systems, such as oil and gas lines, is essential for proper protection against corrosion.

Corrosion occurs when current flows from the steel pipe line to the soil. Protection may be obtained by reversing this action. The proper coating is not always enough to give positive protection against corrosion.

It was recommended that all dissimilar metals be bonded. The installation of test leads for checking stray currents makes regular examinations possible. Cathodic protection can be installed if and when conditions, determined from the test leads, require control.

The cost of cathodic protection for steel water lines is small, if bonding and test leads are incorporated at the time of construction. For insulated pipe lines, the cost of operating cathodic protection was estimated to be $4.85 per mile of pipe per year.

Robert B. Diemer reported that in the Metropolitan Water District of Southern California steel pipe, with coal tar enamel applied, was in excellent condition after 21 years of use.

■ A NEW STRAY CURRENT PROBLEM by Hugh L. Hamilton, A. V. Smith Eng. Co., Narbeth, Pa.

Having had the importance of cathodic protection stressed in the previous paper, the speaker emphasized the significance of a new problem to most municipalities—stray current resulting from the abandonment and removal of transit systems, and conversion of others in many municipalities has promoted cathodic degeneration of steel pipe lines. Many municipal officials are not cognizant of the real impact of this problem.

When other utilities and in some cases buildings have recognized the problem and installed cathodic protection, the steel water lines will suffer even more, unless properly protected.

Water works men should check with other utilities, to determine what they are doing. Philadelphia has a technical force organized to overcome the problems jointly, recognizing the need of cooperation and technical assistance which the various utilities may contribute to the one problem. Drastic action is required if adequate protection to steel water lines is to be obtained in time to arrest a rapidly increasing corrosion problem.

*Reported by R. W. Simpson, Ch. Con. Engr., Gilbert Assoc., Inc., Reading, Pa., and Contributing Editor to *Water & Sewage Works.*

■ Operating Southern California's Colorado River Aqueduct System by Robert B. Diemer, Gen. Mgr. and Chief Engr., Metr. Wat. Dist. So. Calif., Los Angeles.

The construction of the Southern California Colorado River aqueduct was begun in 1932, and placed in operation in 1941. The aqueduct, 242 miles long from the Colorado River to Lake Mathews, cost $180,000,000. Water from the aqueduct and the terminal reservoir, Lake Mathews, is supplied to San Diego, San Bernadino, Riverside, Orange and Los Angeles Counties—which comprises the District.

In the early years of operation, power, in excess of the District's needs, was purchased under contract by Hoover Dam. This excess was subsequently sold to local power utilities. In the past three years, the reverse has taken place, and the District in addition to 36 per cent of the production from Hoover Dam, must purchase power from local utilities in order to pump the increasing water demand.

The District sells water wholesale to its member communities at rates of $8.00 to $12.00 per acre-foot for raw water and $15.00 to $22.00 for softened and filtered water. The water delivered from the aqueduct has increased from 16,000 acre-feet during its first year of operation—1941-42—to 543,000 acre-feet for 1956-57.

While many Southern California communities have been using underground water supplies for general consumption, the over-draft of these supplies is now taking effect, and the communities are beginning to purchase Colorado River water to recharge the underground storage basins.

The District now has an area exceeding 3000 square miles including 83 incorporated cities, a population of 6,500,000 and an assessed valuation of more than $11 billion. New municipalities joining the District must pay the back charges they would have paid had they joined the system at its inception.

An expansion program, started in 1952, will be completed in 1960, bringing the aqueduct to full capacity, at a total cost of $500,000,000. This program when completed, will take care of Southern California until 1975.

■ Plastic Linings and Coatings for Steel Water Pipe by G. E. Burnett, Asst. Ch. Engr., Bur. of Recl., Fed. Center, Denver, Colo.

Nowhere as yet has plastic lining been used in steel water pipes. Its use has been restricted to industrial pipe lines. The Author has been engaged in a study of plastic linings, as they might be applied to steel water pipes. An acceptable lining must be competitive with coal tar enamel and cement mortar lining. The cost for coal tar lining was quoted as 15 to 35 c/sq ft and 20 to 30 c/sq ft for cement mortar lining. Present plastic lining material would cost much more than this.

There is no long term operating experience as yet with plastic lining

G. E. Burnett
Plastic Coatings on Mains

R. F. McCauley
Protective Coatings on Mains

—8 to 10 years for industrial linings. A 10 mil lining is required for electrolytic protection of steel pipe.

Plastic linings must be resistant to damage, and must be easily repairable. Experimental work indicates that to obtain a 5 mil thickness, multiple coats must be applied, and the cost would be 70-85 cents per square foot. Research indicates that while Vinyl and Epoxy resin show promise, methods of application and cost would limit their use.

■ Problems in Locating Elevated Tanks by Clyde E. Williams, Cons. Engr., South Bend, Ind.

There are three considerations to be given to any program to install elevated water tanks: (1) Engineering, (2) public relations and (3) effect on quality of service.

From the standpoint of engineering, factors of system improvement and effect on distribution efficiency must be taken into account. If the tank is on the system, it may be near the pump station or in an outlying district; choice of site must consider elevation, soil conditions, etc.

How the elevated tank affects the public must consider the factor of appearance. The site should have prominence to remind the community of the service being rendered and to advertise the community.

How the tank and its location will affect the quality of service is also important to public relations. If an elevated tank meets the needs of the community and provides good performance, it will be publicly appreciated.

■ Alternate Sources of Power for Water Works by Edward Farmer, Prin. Engr., Black and Veatch, Cons. Engrs., Kansas City, Mo.

The principal purpose of any alternate source of power is to provide reliability of service. Service must be maintained under all possible conditions and calamities. Practical considerations dictate that it should be possible to maintain minimum or near normal operations under infrequent adverse occurrences. On site or internal facilities need more provision for alternate sources of power, but plans should be made to assure that on site failures will not cause shutdowns.

The seriousness of shutdowns varies in different cities; water supply outage usually creates sanitary problems. Power outage is infrequent, but does occur; therefore it is necessary to provide two sources at least. It is suggested that both overhead and underground sources be supplied. Steam standby is expensive; engine driven standbys are best. Booster stations need multiple power sources as reliable as the main station. Elevated storage tanks can be considered as a part of stored power. Plans should be made to expect outages as well as the need for equalization of demand; reserves can be added to with ground storage.

■ Research on Reduction of Water Main Capacity by T. E. Larson, Head, Chem. Sect., Illinois State Water Survey, Urbana, Ill.

The objective of this research is to study the effects of mineral quality on the corrosion and tuberculation of cast iron pipe with specific reference to loss in carrying capacity resulting from tuberculation.

The "unground" interior "as cast" surface of cast iron pipe has been found to have a high resistance to corrosion by water. This "skin" layer is found to consist of two layers,

a gray phase composed of calcium and iron silicates of two different crystal structures and a black phase of magnetite (Fe_3O_4) with a cubic structure.

Laboratory tests are being made to show the effect of pH on the corrosion rates of cast iron with water of zero hardness flowing at 0.1 fps, where the alkalinity is 125 mg/L and the Cl/Alk. ratio is 0.2. Lowest average corrosion occurs at pH of 7.0 with tuberculation on machined surfaces increasing at pH ranges from 7.5 to 9.0.

Other laboratory tests designed to determine the relative influence of sulfate and chloride ions on tuberculation showed no significant difference in corrosion rate or tuberculation in concentrations of 0 to 30 mg/L of sulfate and 3 to 25 mg/L of chloride with water of 85 mg/L of calcium hardness, 120 mg/L of alkalinity and 0.29 $(Cl+SO_4)$/alk. ratio at a saturation index of —0.8, —0.3 and 0.

New test chambers have been designed and other studies are under way on the behavior of particular ions in water at the anode and cathode of a corrosion cell.

■ Research on Developing Protective Coatings for Water Mains by R. F. McCauley, Assoc. Prof., Civ. & San. Engr., Michigan State University, Lansing, Mich.

In these studies both static and dynamic conditions were tested. In the static tests, when no calcium carbonate colloids were present, FeO was formed; in the presence of $CaCO_3$ colloids a harder coat is formed; this coat is usually laid down in 5 days. Most of the coatings were a mixture of 35 to 50 per cent $CaCO_3$ with the rest iron oxide. Better coatings are obtained when the water is saturated with dissolved oxygen. Better coatings are also obtained with lower pH values. The studies are continuing.

Water Resources Division*

■ Research in Evaporation Reduction by Uel Stephens, Director of the Fort Worth City Water Department.

Recent research in evaporation reduction has been carried out by the Southwest Water Evaporation Research Council, Inc. It was interesting to note that all funds for this important research work was subscribed by private individuals, without any Federal subsidy. It is heartening to learn that when an area is faced with a problem such as the water shortage in the Southwest, we do not have to wait for government help. To date $44,110.00 has been contributed to the research program.

Since in many areas, especially in the Southwest, the amount of water lost from municipal supplies exceeds the amount used for domestic and industrial purposes, any method of reducing this loss would have merit.

The application of a Monomolecular Film to Water Surface was the basis for study by the Research Council. The research work included a bibliography of literature on the subject; laboratory screening of 160 different materials; evaluation of most promising compounds on a laboratory scale; larger scale evaluation on stock ponds; treatment of full scale reservoirs on a scheduled test program, with Government Agency clearance.

A. E. Berry
Ontario Water Resources

R. Hazen
Regional Water Supplies

The U. S. Geological Survey cooperated in the program by making the water level observations and records to measure the amount of evaporation. The Public Health Service checked the compounds used to form the film, to determine toxicity, giving final clearance for any compounds to be used.

Laboratory research indicated that the most effective compounds were octadecanol, dodecanol and hexadecanol, the latter offering the best possibilities. Most of the outdoor and field pond work was restricted therefore to hexadecanol (cetyl alcohol). This was the only product completely cleared by the Public Health Service.

The best evaporation retardents, while showing good results in the laboratory, only showed reductions in the field for one or two days. Bacterial action was attributed as the cause of the shorter field durations. The drifting of the film due to wind and wave action, as well as the difficulty encountered in applying the film forming material, also affect the duration of effectiveness.

The work of the Research Council is practically completed. Continuation of the work will be carried out by the Texas Department of Health. The Research Council feels that it is entirely practical to reduce evaporation losses on small farm ponds by the application of monomolecular films. The application to large public water supplies requires further study regarding toxicity, and methods of application.

■ Operation of the Arkansas-White-Red Basin's Interagency Committee by John A. Short, Admin. Officer, River Basin Repr., U.S. Dept. Agr., Tulsa, Okla.

The Arkansas-White-Red River Basin comprises 282,000 square miles, with the rivers draining one-eleventh of the nation's level area. Seven million people reside in the basin—fifty-six per cent of which are rural. The purpose of the Committee is to solve water supply, flood control and irrigation problems. The various agencies comprising the Committee appoint the members and provide the funds. Accomplishments to date indicate that with proper planning, and storage of water at times of peak run off, a regulated supply sufficient to meet future needs will result.

■ Water Quality Studies in the Arkansas-Red River Basin by Keith S. Krause, Asst. Reg. Engr., Wat. Sup. & Pol. Prog. USPHS, Dallas, Tex.

With the increasing need for water in the Southwest, the water shortage in the upper regions of the Arkansas-Red River Basin must be considered. Not only must this area have water, but the water must be of acceptable quality in order to attract industry. The present requirements are two and one-half times the 1955 requirements. The quality of the water is generally poor, restricting its use, and thus restricting industrial growth. The high concentration of mineral contaminants increases the cost of treatment. While the quality is fairly good in the head waters, due to solution of minerals, especially in feeder streams, the quality deteriorates further down

*One session reported by R. W. Simpson, Gilbert Assoc., Reading, Pa., Contributing Editor, *Water & Sewage Works*.

stream. The recent droughts have increased the deterioration in reent years.

The objectives of the studies by the Public Health Service is to determine the factors causing the poor quality; identification of various sources of mineral contaminants; determination of methods of improving the quality. Some of the solutions arrived at to date include the removal of industrial wastes, off-stream storage and the sealing off of geological formations contributing the objectionable mineral contaminants.

Considerable study is needed to solve the problems. With only an average rainfall of 12 inches per year, storage is essential. Data indicates that during flood periods, water quality is good, making storage important from this standpoint also.

Although improvement in water quality appears feasible, more study is required, including study of available data, field investigations of mineral deposits, economic feasibility of methods of control and the source and magnitude of the contaminants.

Dwight F. Metzler, Chief Engineer, Kansas State Board of Health discussed the paper. He indicated the studies under way were initiated by the Public Health Service. The solution to the problem is of prime importance, since industries are avoiding the area due to the water quality. Many of the tributary streams are flashy, providing good water for storage. The sources of contaminants were given as industries, salt mines, oil wells, and irrigation water. In the case of irrigation water, 20 to 60 percent is returned to the streams, with a contamination build-up due to evaporation, and possibly fertilizers. It was estimated that 2 to 3 years would be required to obtain the necessary data to provide a program of relief.

■ WATER WORKS EXPERIENCES WITH THE MISSOURI RIVER BASIN CONTROL SYSTEM by M. P. Hatcher, Director of Water, Kansas City, Mo., with discussions by J. K. Neel, J. F. Erdei, and H. O. Hartung.

The Missouri River Basin Control System covers a 529,000 sq mi area. Due to storage of flood waters now in existence, suspended solids and hardness has been reduced in Kansas City over the past ten years. Results indicate better quality raw water, with some new treating problems.

Dr. Joseph K. Neel, of the U. S. Public Health Service, in discussing results of the control program, indicated that the dams constructed above Omaha have controlled flood waters very well. The turbidity of the river has been greatly reduced. Taste and odor problems have been increased, however. Hardness also has increased. Generally speaking, the water is easier to treat.

Joseph F. Erdei, Chemist, Metropolitan Utilities District, Omaha, Neb., reported turbidity reduction at flood stages from 25,000 mg/L to 4,000 to 5,000 mg/L, with a reduction of suspended solids at all times. Although taste and odor problems ap-

Clyde Williams
Elevated Tanks

Ed. Farmer
Standby Power

pear greater during the summer season, they are adequately controlled at Omaha by chlorination and the use of activated carbon. Although the hardness is higher, there is a more uniform mineral quality. Even though the turbidity is more difficult to remove, softening is much easier.

H. O. Hartung, of the St. Louis County Water Co. reported better water quality, with more frequent taste and odor problems at St. Louis. He further reported higher ammonia contents in the raw water, attributed to industrial pollution.

■ THE IMPACT OF RECREATION ON THE LOWER COLORADO RIVER by Robert K. Coote, Staff Asst., Dept. of Interior, Washington, D. C.

Construction of Hoover Dam, Davis Dam and Parker Dam has made a tremendous improvement in the lower Colorado River Basin. Whereas the flow in the lower Colorado had been erratic prior to construction of the Dams, the flow is now uniform due to control by the dams. Hoover Dam is the key to the control.

The improvement in the lower Colorado has brought with it recreational problems. Many squatters have constructed homes and even businesses on Government property, since there has been no adequate control. The Government plans a program of control for the future, to insure equal usage of the recreational facilities by all.

■ ONTARIO'S WATER RESOURCES by A. E. Berry, Gen. Mgr. & Chief Engr., Ontario Water Resources Com., Toronto, Can.

Opportunity for growth in Southern Ontario is tremendous. However, the need for water spurred action at the Provincial level in 1955 with the formation of a Water Supply & Resources Committee. This was followed by the appointment of a Water Resources Commission in 1956. The Commission was vested with the authority to deal with water problems and all its aspects.

In outlining the work of the Commission, Dr. Berry discussed how the provisions of the Public Health Law had been transferred to the Commission, and that the Commission offered help to municipalities by means of financing, technical assistance, and the employment of operators.

The Commission will also design, build, finance, and operate any water or sewage plant for a municipality. An agreement regarding payment is drawn up between the Commission and the Municipality, and the works or system may then be returned to the municipality after payment is completed. Or, the municipality may extend the agreement for reasons of expansion.

The Commission provides a means of cooperation and technical, financial, etc., help to the municipality. In regard to the financial aspects, the Commission is able to provide funds at a lower interest rate than is normally available for such purposes. Also, the interest rate varies each year according to the current cost of such monies. The Commission to obtain such funds may sell its own bonds or borrow from the Government. In regards to repayment, the municipality pays only for the cost of the facility, the Commission makes no charge for supervisory services, only for the operators actually employed.

The Commission has been given wide powers for the control of pollution and the protection of water. Anything that may impair the quality of water, either from a Public Health standpoint or any kind of pollution

comes under the jurisdiction of the Commission. It is also vested with broad powers to enforce its regulations.

C. G. R. Armstrong, Cons. Engr., Windsor, Ont., Canada, gave a breakdown on how the Commission works in Essex County, Ont., where the Commission integrated several communities into a whole unit for better service. Six communities and one major industry arrived at an equal allocation of costs without recourse to the courts.

A question from the floor asked "Who sets the rates?" Dr. Berry replied that the municipality sets the rates without interference from the Commission. The municipality is obligated to repay the Commission, but the municipality may raise the money by rates or by any means they so desire.

■ REGIONAL WATER SUPPLIES—FINANCING AND COST ALLOCATION by Richard Hazen, Hazen & Sawyer, Cons. Engrs., New York, N. Y.

Under a regional supply, water is usually supplied to the communities distribution system and not further. Under financing, there are usually two systems used: 1) By the issuance of bonds, and 2) Charges to the users. Although some communities pay only for the water consumed, the costs should be based on the value or benefit to the user. Mr. Hazen stated that some method must be found to equalize cost assessments, not only to the communities but also to the counties, etc. who will be helped by the growth of the supplied areas.

■ WATERSHED DEVELOPMENT PLANS FOR THE SABINE RIVER by Mr. J. W. Simmons, Exec. V. P. & Gen. Mgr., Sabine River Authority of Texas, Orange, Texas.

The Authority is now in its 10th year. Created in 1949, the Authority was charged with three major problems: 1) Properly develop the basin; 2) Recommend proper financing of the basin; and 3) Protect the interests of both Texas and Louisiana.

When the Authority was formed, it had no taxing powers and had to operate on self-produced income. It was to this end that it started out by buying a small water system in the lower end of the basin to provide financial independence.

A similar Authority has since been formed in Louisiana, and the two Authorities have made a compacted agreement regarding maintenance of flow.

■ TEXAS WATER PROBLEMS by M. C. Nichols, Chm., Texas Water Development Board, Fort North, Texas, and T. C. Forrest, Jr., Forrest and Cotton, Cons. Engrs., Dallas, Tex.

In the field of underground water in Texas, very little progress has been made for the control and use of this water supply and no control is made over withdrawal of ground water. In the case of surface water, several industries and communities have joined together in the construction of reservoirs.

The Texas legislature has set-up and allocated funds for a Water Planning Board in the Board of Water Engineers. It also established a revolving fund of $600 million for bond issues and the purchase of municipal bonds. This money will be allocated for water projects. Colorful charts and drawings were used to show: principal water-bearing formations in Texas; average annual rainfall in Texas; average annual evaporation in Texas; rainfall-runoff relationship in Texas; rivers and surface reservoirs in Texas; and the Dallas-Fort Worth area surface water problem.

J. O. Jackson
Elevated Tank Standards

H. A. Price
Steel Pipe Specifications

■ A REVIEW OF SANITARY ENGINEERING RESEARCH IN WATER AND SEWAGE by Harry A. Faber, Research Coordinator, Eng. Resources Program, Div. of San. Eng. Services, USPHS, and Bernard B. Berger, Chief, Water Supply & Pollution Control Research, Robt. A. Taft San. Eng. Center, Cincinnati, Ohio.

Mr. Faber in his paper, stated that since the sanitary engineering research grants program of the Public Health Service has been in operation (11 years) a total of 565 grants have been supported, of which 349 (62 per cent) were for research in the field of water supply and water pollution control. In dollars, this represents $5.8 million for sanitary grants as a whole, and $2.8 million for research in the field of water supply and water pollution control.

During fiscal year 1957, there were 81 research grants in the field. These grants received support averaging $9,300,000 and include projects conducted in 44 colleges and universities, two State Health Departments, one State water agency, and one private laboratory. In the classification of grants now in existence, investigations into treatment methods totaled 32; water pollution studies 30; analytical methods 12; and toxicity studies 7.

All the technical developments in sanitary engineering practices rest on the exploitation of basic thoughts mainly conceived at the turn of the century. The supply of new ideas regarding practices are on the decrease. Therefore, new and more modern basic ideas must be developed for the sanitary engineering practices of tomorrow.

In comparing the amount of monies spent by business for research and development, and that spent for water supply and water pollution control research, for every $1,000 spent by business, water pollution control spends ten cents.

In analyzing the future of pollution research, Mr. Faber concluded that very little of the research conducted by industry and by scientific institutions is "fundamental" research. And, "fundamental" research at this time could be the main factor in reducing the cost of pollution control in the future.

The Sanitary Engineering Services of the Public Health Service is continuing with its project of a "Research Inventory" that will provide a classified record of what research is being done, who is doing the research, and the source of support.

B. B. Berger reported that the Taft Sanitary Engineering Center is currently conducting about 20 research projects on water supply, sewage and industrial wastes.

One of the newest projects is fundamental research on organic contaminants, as these contaminants are not being treated adequately at the present time. Toxicity studies are also being conducted on organic chemicals reaching water supplies.

Under the general heading of virus

studies, the transmission of infectious hepatitis virus through contaminated water is being conducted along with a long range study on the methods for recovery, identification and enumeration of viruses in water treatment.

In the review of design criteria, the center is testing synthetic organic coagulant aids and the improvement of disinfection procedures.

There are three main areas of investigation under conservation studies: 1) recharge of natural underground formations; 2) use of monomolecular films on surface reservoirs; and 3) development of cheaper and more effective methods for separating suspended and dissolved solids from wastes.

Some of the other projects under study in the water supply field are: 1) Identification and control of odor producing substances; 2) Development of a multiple tube technique for coliform count; 3) Development of water purification processes applicable to individual owned and operated water supplies; and 4) The report on the membrane filter technique is nearly completed.

In the field of sewage treatment, there are three types of treatment processes currently under investigation: 1) Stabilization ponds; 2) Anaerobic treatment; and 3) Bio-oxidation surfaces.

Industrial Wastes come under three broad research areas: 1) Procedures for characterizing wastes; 2) Determination of tolerable levels for industrial waste components in municipal sewage treatment plants; and 3) Investigation of new principles of industrial water treatment. This includes study on kinds, requirements and control of organisms useful in the destruction of organic chemicals. It also includes the exploration in the field of microbial genetics.

Concluding presentation, Mr. Berger listed 9 representative projects throughout the United States having research value to such an extent that the Taft Center is performing technical assistance or services to aid in their completion.

Water Works Practice Committee

Protective Coatings

■ SELECTION OF PROTECTIVE COATINGS FOR VALVES AND HYDRANTS by Loring E. Tabor, Specification Engineer, Dept. of Water & Power, Los Angeles, Calif., on the Selection of Protective Coatings for Valves and Hydrants.

There is no perfect coating. In the trouble encountered in double-disc gate valves and hydrants, the biggest problem encountered by Los Angeles was the freezing of valves by dezincification. After a five year period the valves were found to be almost completely clogged as a result. This took place in spite of a protective coating applied prior to use. The department then went to all bronze parts, but even the bronze specifications had to be changed after river water started to enter the system. It was also found to be effective, if in addition to the bronze, all inside surfaces were painted with two coats of varnish.

A wide variety of protective coatings were investigated, everything from English glass glazing to epoxys, but these studies found nothing new to recommend at this time.

■ EFFICIENT FIRE HYDRANTS by Gerard A. Wyss, Sr., Engr. Distribution Design Sec. Dept. of Water & Power, Los Angeles, Calif.

Mr. Wyss told the story of how the "Fire Plug" got its name. Old wooden water pipe had a hole drilled in the pipe and a wooden plug was hammered in, hence the name "Fire Plug." The Fire Underwriters have had a tremendous influence on regulation and installations of fire hydrants. It was recommended that at least one 4-in. hydrant outlet be provided for each pumper unit to be called to the fire.

■ STANDARDS FOR CONSTRUCTION AND PAINTING OF ELEVATED TANKS by J. O. Jackson, Pres. Engineering Development Co., Corapolis, Pa.

The only new development in the field is that of radiography inspection of circumferential welds on tanks was now permitted.

■ OIL LINE RIVER CROSSINGS by M. B. Cunningham, Dir. Pub. Wks., Oklahoma City, Okla.

Each Oil-Line River Crossing must be custom built to fit the particular hazards encountered. Water engineers should work with the oil companies in the design stages of the crossings prior to start of construction. Detection equipment should be installed to warn of breaks or leaks in the oil lines. These devices can be installed in the oil line itself or at the water intake.

■ STEEL PIPE MANUAL by H. A. Price, Senior, Project Design Engr., Dept. of Water & Power, Los Angeles, Calif.

New specifications may be published in one volume, and would contain a recommended practices guide. Other items to be included would be a specification section on accessories and couplings, and specifications for the adaption of steel pipe for industrial waste uses. The present specifications are for steel pipe 30-in. and above, next year there will be specifications on steel pipe from 4-in. and above up to 30-in.

Under recommendations for study, Mr. Price suggested the use of high tensile plate, 200 psi or greater, for large diameter pipe. The use of this plate for 15-ft diameter pipe should represent a large saving. Also recommended for study was the use of rubber gaskets for steel pipe. San Diego saved $400,000 by specifying rubber gaskets for use on the San Diego aquaduct. San Diego plans to test and examine this installation for a period of two years before changing the specifications.

Alternate Formulations for Cetyl Alcohol

Commercial cetyl/stearyl alcohol used to mist reservoirs to control evaporation may be obtained in flake, block or bead form. Formula is:

Cetyl alcohol—45%
Octadecanol alcohol—40%
Myristyl alcohol—10%
Unsaturated alcohols (mainly oleyl) 5%
  Iodine value—4 maxi.
  Acid value—0.1 maxi.
Saponification value—0.5 maxi.
Hydroxyl value—220 to 225
Melting point—48 to 50°C.

Formula of the grade commerical cetyl alcohol in East Africa is:

Cetyl alcohol—70%
Octadeconol—18%
Myristyl alcohol—7%
Unsaturated alcohols (mainly oleyl)—5%
  Iodine value—3 to 6
  Acid value—0.3 maxi.
  Saponification value—1.0 mazi.
  Hydroxyl value—224 to 230
Melting point—46 to 49°C.

Another grade has the formula:

Cetyl alcohol—43%
Octadeconol—45%
Myristyl alcohol—7%
Unsaturated alcohols—5%
  Iodine value—4 maxi.
  Acid value—0.1 maxi.
  Saponification value—0.5 maxi.
  Hydroxyl value—217 to 223
Melting point 49 to 52 degrees C.

Meeting in Chicago included sessions devoted to . . .

Radioactive Contamination of Water

A report by G. H. TELETZKE, Associate Professor of Sanitary Engineering, Purdue University, W. Lafayette, Indiana.

EDITOR'S NOTE: The subject of radioactive fallout and the treatment and disposal of radioactive wastes is of growing importance to the field of water supply. The 1958 Nuclear Engineering and Science Congress recognized this fact and scheduled two half day sessions on waste treatment and water contamination. Papers on the subject of water contamination are reported here; those on the treatment of wastes from industrial establishments are reported by Prof. Teletzke in the July-August issue of *Industrial Wastes*.

■ STUDIES OF RADIOACTIVITY IN THE CHICAGO WATER SUPPLY by J. C. Vaughn, R. W. Schmidt, Alfred Tenny and Arthur Shor, of the Department of Water and Sewers, City of Chicago.

Six years of experience monitoring the water taken from Lake Michigan has shown the activity to be usually less than 10^{-8} μc/ml. During periods of nuclear weapons testing the activity may rise to 10^{-7} μc/ml. Limited data shows that approximately 40 per cent of the radioactivity is removed by conventional treatment.

■ SOME METHODS FOR THE DETERMINATION OF RADIONUCLIDES IN WATER IN LOW CONCENTRATIONS by B. Kahn and S. A. Reynolds, of the Oak Ridge National Laboratory.

The authors described methods for concentrating the radioelements: zirconium, niobium, iodine, ruthenium and strontium. Methods employed included precipitation, solvent extraction, distillation of ion exchange. Also discussed was the use of gamma scintillation spectrometry for the identification of radionuclides.

■ THE USE OF THE GAMMA SPECTROMETER FOR THE IDENTIFICATION OF RADIONUCLIDES IN WATER by C. R. Hagee, A. S. Goldin and C. P. Straub, of the Taft Sanitary Engineering Center.

Presiders at the session on water contamination were John R. Baylis and H. H. Gerstein, both of the Chicago Water Department, shown here, and Carlos G. Bell, Jr.

The authors discussed, in detail, the use of gamma scintillation spectrometry. Gamma spectra obtained from Nevada soil, rain, cistern water, cistern sludge, particulate matter in air, and milk were shown. The spectra of environmental samples of recent origin were characteristic of fission products of short half-life. Older samples showed the longer half-life isotopes cerium-144, zirconium-niobium-95 and ruthenium-106.

Coagulation Studies

■ LABORATORY CHEMICAL COAGULATION STUDIES ON THE REMOVAL OF FALLOUT RADIOACTIVITY IN WATERS by L. R. Setter and Helen H. Russell, of the Taft Sanitary Engineering Center.

The authors summarized laboratory studies made over a three-year period on the coagulation of radioactive rain, cistern and surface waters, and water extracts of soil containing bomb debris. Alum, hydrated lime and coagulant aids in various combinations and at various pH values were used. Laboratory jar tests with dosages usually used in conventional water treatment indicated that all suspended beta activity and part of the soluble beta activity could be removed. Removal of the remaining activity became increasingly more difficult the longer the waters were exposed to natural purification processes. Coagulation at pH 10 with alum and lime was found most favorable for removal of strontium-90.

■ THE ADSORPTION OF RADIOACTIVE SUBSTANCES ON WATERBORNE AND CONSOLIDATED MATERIALS by F. B. Barker, of the U. S. Geological Survey.

Mr. Barker discussed the preliminary results obtained in evaluating the ion exchange capacity of five types of clays. The experiments showed that calcium and sodium ions interfere with the adsorption of cesium to a nearly equal extent; whereas, calcium has a much greater effect on strontium adsorption than has sodium. The adsorption of radioactive ions on clay is influenced by the calcium and sodium concentration and also the concentration of the radioactive ion.

■ A Field Test of the Movement of Radioactive Cations Through an Underground Formation by Ben B. Ewing, of the University of California.

In the test a synthesized radioactive waste containing Sr-39 and Cs-134 was pumped into a permeable formation. The movement of the two isotopes was monitored by observation wells at various distances and directions from the injection point. The rate of movement in the permeable formation was predicted from laboratory studies conducted on material taken from the same formation. At the time of the report, injection had been in progress for over 90 days. Strontium reached two monitoring wells 13 feet from the injection point after a mean travel time of about 14 days. This compared very well with the predicted travel time for one well but was only about half that predicted for the other. At the time of the report, cesium had not reached the wells 14 feet distant, although the laboratory tests indicated that it should have been present within the 90-day period. Observations are continuing.

■ Radionuclides in Reactor Cooling Water — Identification, Source and Control by D. W. Moeller, of the Robert A. Taft Sanitary Engineering Center, and G. W. Leddicotte and S. A. Reynolds, of the Oak Ridge National Laboratory.

This article summarized studies made on the identification source and control of radionuclides in the cooling water system of the Low Intensity Testing Reactor at Oak Ridge.

■ Cross Connections: Their Prevention and Control in the Y-12 Plant of Union Carbide Nuclear Co. at Oak Ridge, Tenn. by G. J. Angele, of Union Carbide.

Mr. Angele discussed the program inaugurated to prevent and control cross connection in the rehabilitation of the former Electro Magnetic Separation Plant used during World War II.

A session on the problems and treatment of radioactive waste from industrial establishments is reported by Prof. Teletzke in the July-August issue of Industrial Wastes.

Southern Municipal and Industrial Waste Conf.

Seventh annual meeting at Duke University heard about . . .

Responsible Water Use Policies

A report by CHARLES M. WEISS, Associate Professor of Sanitary Science, University of North Carolina, Chapel Hill, North Carolina.

EDITOR'S NOTE: Each year, Duke University, University of North Carolina, and North Carolina State College jointly sponsor a conference on municipal and industrial waste treatment. This seventh meeting dealt with the theme of responsibilities of industry, local government, consulting engineers, and researchers in the matter of maintaining clean streams. Most of the papers were concerned with industrial waste and have been reported by Prof. Weiss in the July-August issue of *Industrial Wastes*. Those dealing with municipal problems are reported here.

■ "Protection of Wildlife Resources by Water-Use Policies" by J. H. Cornell of the North Carolina Wildlife Resources Commission. Wildlife resources are protected when state water policies provide water of suitable quality and quantity to maintain wildlife. Where there is an abundance of surface water, as found generally in the Eastern United States, the "riparian rights doctrine" has generally been the basis of water usage. Each riparian landowner is entitled to the water flowing by or through his land relatively undiminished in quantity and unchanged in quality. Under conditions of water scarcity, the doctrine of prior appropriation generally governs water usage. The general basis of the doctrine being that so long as the water is put to a beneficial use the person who gets control of it first is entitled to use it regardless of the needs of others. Mr. Cornell noted that in many areas of the East the riparian rights laws were being attacked by various groups with the intent of substituting prior appropriation rights. With increasing demands for water from many users, Mr. Cornell concluded that eventually a state regulating body, a Water Resources Commission representing all water users, would have to be set up to decide the best public use of available water. Their area of interest would include pollution control, quantity control, navigation and flood control, ground water supplies and planning for future uses.

■ "Responsible Water Policies—Agricultural Viewpoint" by J. W. Fitts, Head, Department of Soils, School of Agriculture, North Carolina State College.

Professor Fitts discussed principally the behavior of water in soils and the capacity of soils to hold water. He related these conditions to the types of soil and the manner in which water becomes available to plants growing in the particular soils. He emphasized the importance of the soil micro-organisms in the moisture relations of the soil and the growth of the higher plants. Research is needed to determine how root zones can be deepened, to tap new water horizons, and how to maintain soil in good tilth with adequate protection against wind and water. Moisture problems in agriculture are not a one-farm affair but must be considered for the entire watershed in which the farm is located.

■ Legal Concepts for Responsible Water Use-Policies" by Milton S. Heath, Jr., of the Institute of Government, University of North Carolina.

Mr. Heath noted that water usage is one of resolving conflicting interests: agriculture, industry, municipalities, power companies, water recreation and navigation.

The basic obligation of the law is to balance conflicting public and private interests in water resources, to minimize conflicts and provide efficient ways to settle disputes. The law must also contend with the interests of riparian and non-riparian owners, overlying and non-overlying owners and what has been called the "upper level spirit of conquest" versus the "lower level spirit of exclusion."

Legal problems that have to be reconciled in solving the conflicting uses can be described under the headings of ownership, measurement, timing, classification, form and administration. In several instances legislation concerning water rights has been enacted that is unsound from the point of view of hydrology and geology.

There may be functional alternatives to legal regulation of water use. Conflicts in water usage might be minimized by increasing dependable supplies through more extensive flow regulation and reservoir storage. Water problems that have their roots in inadequate municipal planning, engineering, or financing, are publicized and discussed as analogous to the traditional problems of the West, the region of water scarcity. Thus, a myth develops that America has a single water problem.

The future shifts in legal doctrine governing water usage, Mr. Heath anticipates as follows: There will be an increasing stress on public interests in water resources through more extensive state regulations of water quantity as well as quality and more intensive planning for water use. In addition there will be some adjustment in ownership and measurement doctrines made necessary through the process of growth. This may include a relaxation of watershed restriction on water use and increasing attention to the effects of flow regulation. If legal changes adversely affect existing rights, the owners will in most instances be compensated for their losses.

Other Topics

■ "The Profession of Environmental Health Control" by Professor Benjamin A. Whisler, Department of Civil Engineering, Pennsylvania State University. Professor Whisler emphasized the basic necessity of avoidance of rigidity in all factors involved in the employment of professional men in environmental health control. There should not be specifications detailing exact educational and experience backgrounds for any job, but men should be hired for their general educational qualifications and experience and their general potential with respect to their ambition and interest in the work. Once employed, additional education and advancement in rank and salary should be based on proven ability alone, and satisfactory discharge of duties should be the only criterion for continuing employment.

Dr. Charles M. Cameron, Associate Professor of Public Health Administration, School of Public Health, University of North Carolina, discussed new aspects of biological pollution with specific reference to diseases that have in recent years been found to be transmitted by water such as infectious hepatitis and others of viral etiology. He also noted that many new viral agents have been found to be transmittable via water and the partial or marginal water treatment methods are largely ineffective in controlling them.

Papers by Stanford E. Harris, Superintendent, Department of Water and Sewage, Winston-Salem, North Carolina, Wade Gillies Brown, Assistant Superintendent, Water and Sewage Department, Durham, North Carolina, and Robert S. Phillips, Assistant Superintendent, Water Department, Charlotte, North Carolina, were presented under the topic heading "Planned Municipal Programs." These papers dealt with the manner in which these three communities handled the problem of handling increasing volumes of industrial wastes in the municipal treatment plants.

Thomas M. Riddick, Consulting Engineer and Chemist of New York, discussed with illustrations from his experience the responsibilities of a consulting engineer. These he described as responsibilities to his client, to his profession, to himself and to organized society.

The Eighth Southern Municipal and Industrial Waste Conference will be held April 2 and 3, 1959, at the University of North Carolina, Chapel Hill, North Carolina.

"They should be first among *all*, who contribute most to the good of *all*"—*Mazzini*.

Are you sure we're putting chlorine in the water???

As a Yardstick of Pollution, How Good is the

MPN Coliform Index

Asks EDMUND J. LAUBUSCH, Sanitary Engineer, The Chlorine Institute, New York, N.Y.

RESUME: The dilution technique for the determination of most probable numbers of coliform bacteria in water has several limitations. Not the least of these is that the results depend on the number of tubes observed in each dilution and may be greater than the "true" coliform density (as much as 23 per cent high for a series of 5-5-5 tube tests and 43 per cent high for a series of 3-3-3 tests). Other limitations include deficiencies in laboratory technique and personal errors associated therewith, differences of sensitivity of alternate procedure methods, influence of one variety of organisms on another, lack of true randomness of bacterial distribution, etc. For these reasons, the MPN by the dilution method should not be treated with sacred reverence.

Application of the Micro Filter Technique offers a means to reduce the elements of uncertainty in the MPN Coliform index.

■ INHERENT LIMITATIONS in the application of fermentation tube test methods in bacteriological examinations of water, and consequent difficulties in their mathematical and practical interpretation, generally are unrecognized by more recent entrants into the specialized field of water resources and quality control. Others, more intimately associated with the historical development of conventional technics, often are prone to disregard or overlook the principles involved in their application and interpretation, thereby reaching dubious and ofttimes misleading conclusions. A brief recapitulation of some of the more pertinent considerations appears warranted and is the subject of this report.

The following major questions are timely with regard to application of dilution tube technics for estimating coliform density:

1. What is the actual significance of the coliform population in water?
2. How accurate are the usual coliform estimates, and what contributing factors are involved?
3. What technic is most satisfactory (consistent with time, effort, reproducibility, expense, etc.), and what degree of precision can be anticipated?

Basis of Coliform Sampling

Consideration of the actual sanitary significance of the coliform population in water as a yardstick of pollution is a complete subject in itself and is outside the scope of this discussion. It is important to remember, however, that much controversy yet exists on the subject. Objections have been particularly apparent over the past decade, attributable largely to problems associated with the newer concepts of an ever-changing environment, to unbiased and substantiated scientific observations, and to epidemiologic conjecture postulated since the acceptance of the coliform group of organisms (or their equivalent) as indexes of pollution and yardsticks of sanitary quality.

Current usage of the coliform group of organisms in appraising the bacteriological safety of water is based on the hypothesis that their numbers are considered a fair index of the extent of intestinal pollution, and their presence is considered as valid evidence that the water has been subject to pollution. Research is indicated to explore further the dynamics of coliform indexes for describing and establishing the sanitary quality of water.

The validity of the results of bacteriological examinations of water is influenced by certain necessary assumptions in sampling, as well as by the technics of analysis employed. In applying the results of bacteriological examinations on a practical basis it is considered, of necessity, that the sample collected and examined is representative of the water quality during the interval between consecutive samplings at the same point. (The frequency of sampling itself is dependent on local requirements and subject to considerable variation.)

It is further considered that the distribution of sampling points is such as to give a true picture of the bacteriological quality of the total water supply system. Although these considerations are fundamental and necessary to the evolution of quantitative and qualitative criteria of safety, it is recognized that they are not unequivocally applicable.

Limitations of Conventional Technics

It would not be warranted, of course, to design or utilize a methodology for determination of coliform density which yields results more accurate than those which can be realistically achieved within the limits of ordinary experimental and personal sources of variance. Indeed, the most elaborate mathematical formulas proposed, and there have been many over the past forty years, do not appear to approach this limit of accuracy.

It is a fact so well-established as to require no further discussion that the results of a bacteriological examination of a sample of water should be correlated, wherever possible, with a sanitary survey to enable a just estimate of the sanitary quality of that supply. With full appreciation of this, standards of water quality are defined solely on the quantitative results of laboratory examinations in recognition of the impracticality of including such a requirement.

Over the years, in developing standards, proponents have emphasized the inherent dangers of rigid and automatic application and have recommended professional judgment and discretion in the interpretation of laboratory results—a recognition too often neglected by those responsible for evaluation or certification of the safety of a water supply. Such a recommendation takes cognizance of the fact that the relation which the bacterial estimate bears to the actual safety of a water supply is variable and, to some extent, indeterminate.

For MPN determinations, the minimum number of tubes planted for a sample is governed principally by the facilities available, and the time required for the analysis commensurate with the value of the results achieved.* In practice, considerable variation is observed; however, the bacteriologic standard is so phrased as to permit quantitative interpretation of results on the basis of five 10-ml portions per sample. As few as one or as many as five portions are generally planted, and the number of dilutions, if any, is based on a knowledge of the sanitary history of the water being sampled.

The currently accepted "Standards,"[7] which involve planting of a minimum of five 10-ml portions, were not altogether accidental. There appears to be no rational basis in the establishment of a minimum of five portions, rather than say ten or more, except that it is necessary to limit the amount of labor and materials involved to such an extent that the results are commensurate with the requisite accuracy—an entirely reasonable approach.

The most accurate method of evaluating fermentation tube test results in terms of a determinate number is still open to dispute, although in more recent years this is less obvious due to the general acceptance and convenience of tables of most probable numbers from the Hoskins[4] adaptation of the Reed[8] formula based on the Poisson random distribution. The discussion which follows relates to limitations in the interpretative value of the coliform density so derived.

Evolution of MPN Technic

Bacterial population estimates based on the presence or absence of growth in tubes had an early origin, although utilization in sanitary bacteriology was realized only a few decades ago.

The Phelps Index was used extensively for many years before the advent of the MPN method of estimating coliform concentration in water. The method was based on the concept that the coliform density per ml is the reciprocal of the sample volume contained in the smallest portion (or highest dilution) showing growth. A completely uniform distribution of organisms in the sample was assumed, and the probability that gas-positive portions of the highest dilution of the sample may contain more than one organism (resulting in a density estimate lower than the true value) was neglected. Moreover, in instances where growth is obtained in a dilution higher than one in which none is obtained, interpretation is arbitrary. It is apparent that the Phelps Index does not apply to the case of multiple-dilution tests or, for that matter, to more than one tube in each of a series of dilutions.

McCrady[5] is credited with the original approach, about 1915, to the problem of estimating bacterial population from dilution tests utilizing the statistical probability theory. Shortly thereafter others[3, 4, 8] became interested in the interpretation of dilution data based on random and independent distribution of organisms in the sample and introduced formulas and graphs to facilitate application of their theories. It is interesting to note that Gordon,[2] in 1938, took issue with this rather consistent and uniform approach by questioning the validity of the common sampling assumption that individual bacteria are distributed independently at random, and proposed a method which he believed less affected by bias attributable to this source. In the intervening years, there have been no radical departures advanced in challenge to proponents of the original statistical theories.

Validity of MPN Estimates

Application of the MPN technic is based on the following assumptions:

1. Organisms in the sample are distributed at random.
2. Organisms exist independently of each other.
3. A single organism is sufficient to give a positive test.

In some instances all these may apply; in other instances they are completely lacking.

The validity of the maximum likelihood estimate (MPN) of the coliform density in a water sample by the conventional fermentation tube method depends, in considerable measure, on the sequence of dilutions of the sample inoculated. Two typical examples follow.

TABLE 1

Combinations of Growth-Positive and Growth-Negative Fermentation Tubes When a Single Tube Is Inoculated in Three Dilutions in Geometric Series*

Case	10 ml	1 ml	0.1 ml	MPN/100 ml
a	+	+	+	> 240
b	+	+	—	240
c	+	—	+	95
d	+	—	—	23
e	—	+	+	19
f	—	+	—	9.4
g	—	—	+	9.0
h	—	—	—	< 9.0

*From Hoskins' tables of MPN's[4].

* In the "1914 Drinking Water Standards," applicable to waters supplied for the public by interstate carriers, it was recommended that five 10-ml portions be planted, and routinely, one 1-ml and 0.1-ml portion of each sample also be planted to "demonstrate more fully the extent of pollution in grossly polluted samples." In the "1925 Standards," less emphasis was placed on the latter recommendation in recognition of the lesser range of pollution anticipated for waters offered for certification. In the "1946 Standards" the multiple-portion, geometric dilution series planting was recommended when three or more of the five equal 10-ml portions showed the presence of organisms of the coliform group, and when waters of unknown quality were being examined.

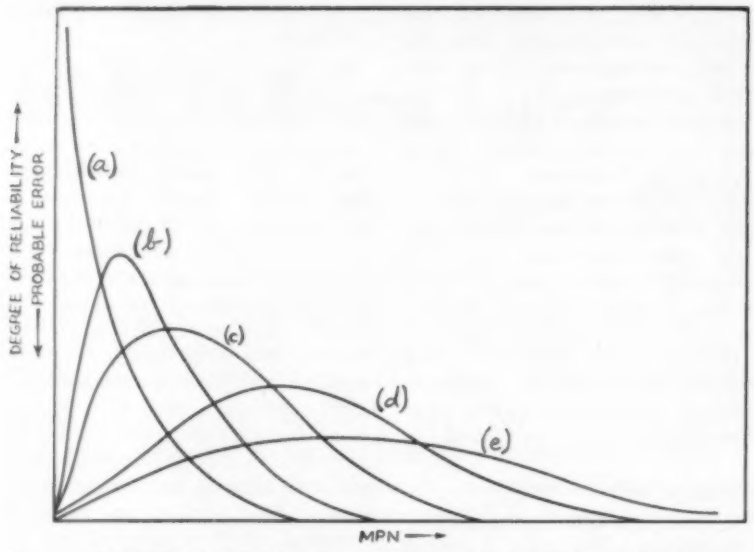


Fig. 1—PROBABILITY CURVES: Single-dilution technic with five 10-ml portions inoculated.

Condition I

(N number of tubes in each of three dilutions in geometric series). A common procedure especially adaptable to the analysis of a non-potable water sample, sewage, shellfish, etc., consists of inoculating one or more tubes in each of three dilutions in geometric series; for example, 10 ml, 1 ml, and 0.1 ml. The cases likely to arise when a single tube is planted in each of these three dilutions (a 1-1-1 test) are shown in Table 1.

These cases are listed according to the value of the MPN. Cases c, e, f, and g are anomalies but are not infrequent occurrences; they are, as Reed[8] implies, as logical as are the other cases. Cases c and f, however, are about 10 times more common than g, and almost 100 times more common than e. Cases a and h are indeterminate and are likely to develop when the coliform density is very high or very low.

The rapid changes in these MPN's indicate that the yardstick employed in the instance of the multiple-geometric dilution series for estimating coliform population is not very refined. In such a series the lowest determinate MPN obtainable from only one positive 10-ml tube is 23 per 100 ml (1/1-0/1-0/1); the range extends to 240 per 100 ml (1/1-1/1-0/1). On the other hand, for a 5-5-5 series, the lowest MPN obtainable from one positive 10-ml tube is 2 per 100 ml (1/5-0/5-0/5), and the range extends to 1,600 per 100 ml (5/5-5/5-4/5). The rather obvious conclusion follows, as shown in Table 2 that an increase in the number of portions planted in a geometric dilution series does tend to give a better measure of the MPN.

Condition II

(N number of tubes in a single dilution). The relationship between the MPN and analytical findings when N equal portions of a sample are examined is relatively simple in comparison to Condition I or when a random number of tubes at different dilutions are inoculated with random portions of sample.

The current standards for waterworks practice provide for at least five 10-ml tubes to be tested. The cases likely to arise are shown in Table 3.

Reed's plot[8] of the frequency distribution for each of the above cases, typified by Fig. 1, clearly shows that this technic is particularly applicable for measuring a relatively narrow range of pollution (as measured by MPN), and that the refinement is considerably greater, for example, than that for an equivalent number of tubes in geometric series (Condition I). The deficiency can be reduced somewhat by increasing the size of the five uniform portions to, say 100 ml, where the corresponding range would be between 0.22 and 1.6 organisms per 100 ml.

Analyzing the relative variability between Condition I and Condition II: for the latter when only one of the 10-ml portions is positive (Case b), the MPN is 2.2 per 100 ml; for the former (Case d), the MPN is 2.3 when a 100-ml portion is positive and all higher dilutions (lower concentration) are negative. If Reed's frequency curves for these two conditions are compared (Fig. 2), it becomes apparent that although the modes (MPN's) of the two are essentially the same, the curve for the multiple-dilution series technic is much broader than that for the single-dilution series.

The MPN, representing the mode in a probability or frequency distribution, gives no indication whatever of the form of the distribution. Thus, although each specific condition suggests approximately equal degrees of pollution, the probable error for the geometric series technic (I) is considerably greater than that for the single-dilution procedure (II) outlined by "Standard Methods."[9]

This also may be demonstrated by examining the area of the curve (a measure of probability) greater than the MPN represented by the vertical axis, x, shown in Fig. 2. For Condition I, the area is obviously considerably greater than that for Condition II, again indicating that the probability that the MPN exceeds x is much greater when the geometric series technic is employed than when only one dilution is used. Thus, if the bacterial density of the sample can be

TABLE 2

Probable Limits of MPN When More Than a Single Fermentation Tube Is Inoculated in Three Dilutions in Geometric Series*

No. Tubes In Series	No. Tubes	(Lower Limit) MPN/100 ml	No. Tubes	(Upper Limit) MPN/100 ml
1-1-1	1/1-0/1-0/1	23	1/1-1/1-0/1	240
2-2-2	1/2-0/2-0/2	6.0	2/2-2/2-1/2	700
3-3-3	1/3-0/3-0/3	3.6	3/3-3/3-2/3	1,100
4-4-4	1/4-0/4-0/4	2.6	4/4-4/4-3/4	1,400
5-5-5	1/5-0/5-0/5	2.0	5/5-5/5-4/5	1,600

*From Hoskins' tables of MPN's[4].

roughly estimated, the use of three or more dilutions in an indiscriminate range contributes little to the accuracy of the final result.

Interpretation

It is apparent that although the MPN index is a valuable device for placing the bacterial density estimate in terms of a discrete number, all MPN's obviously are neither equally reliable nor do they represent the actual density of organisms in the sample. At best the MPN is only approximate, especially when the number of tubes, N, is small, the reliability increasing with increasing values of N.

Thomas *et al.*[10,11] have established that the precision of a multidilution MPN test depends on the number of tubes observed in each dilution rather than on the bacterial density, and that the standard sampling error may be made comparatively small if a large number of replicate tubes are tested.

They also demonstrated that the "apparent" coliform density, based on the arithmetic mean of a series of MPN's, often is greater than the "true" coliform density because of the bias of an MPN estimate, a function of the number of tubes planted in each dilution. Their statistical computations suggest that the amount of bias is in the magnitude of approximately 23 per cent (higher than the "true" density) for a series of 5-5-5 tube tests and 43 per cent for a series of 3-3-3 tests on the same sample (based on the "Standard Methods"[9] completed test). That is, if a large number of replicate 5-5-5 tubes are examined from water containing a true coliform density of 100 per 100 ml, on the average the arithmetic mean or apparent MPN will be 123 instead of 100. A disparity of such magnitude obviously cannot be overlooked.

In interpreting the results of fermentation tube data, it also should be remembered that the MPN, representing merely a mathematical attempt to define a discrete estimate of the most likely bacterial density, is certainly no more reliable than the experimental technic on which the evaluation is based. Furthermore, it is dependent on the validity and rationalism of the assumptions upon which application of the theoretical principles involved are predicted. As mentioned previously the assumption of randomness of the bacterial distribution may or may not apply for a particular case.

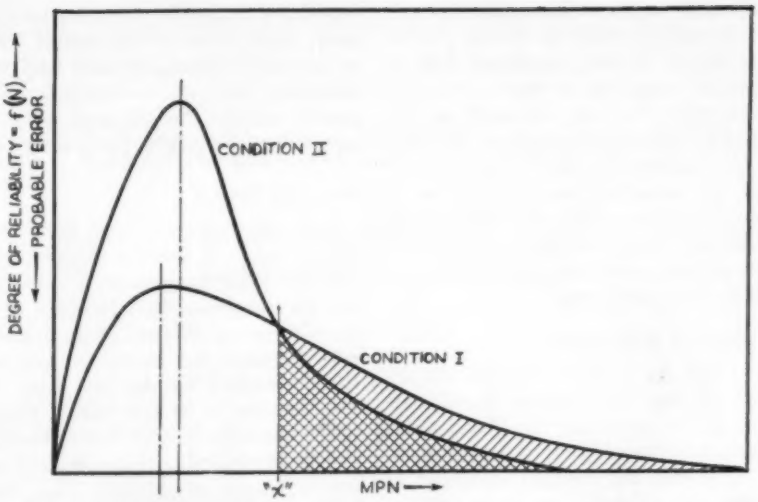


Fig. 2—FREQUENCY DISTRIBUTION: Multiple serial dilution (Condition I) vs. single dilution (Condition II), showing relative variability (probable error) where degree of pollution is apparently similar.

The validity of such an assumption, of course, cannot be accurately determined for any sample; however, its very intangibleness reflects on, or at least limits, the degree of confidence which can be attributed to the final result. It has been estimated, for example, that even when a sample contains one coliform per ml, about 37 per cent of all 1-ml portions examined would be expected to yield negative results[9]; and, if five 1-ml portions are examined, a completely negative result (that is 0/5) would be expected to occur in less than one out of 100 tests. Even so, the precision that can be expected cannot be considered of a high order.

The fermentation tube technic has an additional weakness attributable to the assumption (again reasonable, but unfortunately not always valid) that organisms of one variety exert no appreciable influence on the viability and growth of organisms of another (for example, in the case of coliform density examinations, cognizance is not taken of the effect of metabolic processes of non-coliforms or the action of predatory protozoa). The effect of this antibiosis phenomenon[1] can be minimized when, for a given sample volume, the size of inoculum is decreased and the number of portions is increased. Whether this tends to compensate, however, for the errors introduced when the portion size is small (for example, ten 10-ml portions vs one 100-ml portion*) is very doubtful.

In addition to deficiencies in actual laboratory technic involved, and personal errors associated therewith (some of which tend to be compensatory), the utility of fermentation tube test results is further limited by differences in the sensitivities of alternate permissible procedures; for example, brilliant green bile vs EMB agar in the confirmatory test for coliforms.† Experimental sources of variance, not only peculiar to the fermentation tube technic, do contribute, of course, to the precision of the results.

Each of these, not purported to represent the totality of factors bearing directly on the accuracy or precision of the MPN technic, does tend to limit the degree of reproducibility of the results which can be anticipated,

TABLE 3
Probable Limits of MPN When Five Fermentation Tubes Are Inoculated in a Single Dilution*

Case	No. of Positive Tubes	MPN per 100 ml
a	0/5	< 2.2
b	1/5	2.2
c	2/5	5.1
d	3/5	9.2
e	4/5	16.1
f	5/5	> 16.1

*From the U.S.P.H.S. "1946 Drinking Water Standards"[7].

* Often, pollution demonstrated in the examination of a 10-ml portion passes undetected in the examination of ten 10-ml portions identically tested.[4]

† There is evidence that these media do not differentiate precisely the identical group of bacteria, the bile medium usually producing a higher "coliform" recovery.[10]

especially under routine performance. Although this may be of little practical import in many instances, it is of especial significance where quantitative evaluations are indicated; as, for example, when the efficacy of two different technics is being compared, or in appraising the sanitary quality of milk, streams, shellfish-producing waters, etc. Such a distinction, of course, is of paramount importance, but too often it is disregarded.

Status of MPN Technic

Over the years it has become accepted that the coliform index constitutes a reasonably good and accurate measure of quantitative pollution. Of course, the method employed to obtain an accurate estimate of coliform concentration ideally should yield statistically reliable results, over a wide variety of samples with different physical, chemical and biological characteristics, in as short a time possible; it should be simple and practicable in terms of material, space, labor and interpretative skill required; and it should be sufficiently economical to permit regular and frequent application. Except for occasional objectors, fermentation tube tests (single or multiple dilutions) have been recognized as most nearly approaching the foregoing performance criteria. Indeed, many who should know otherwise treat of MPN's with an almost sacred reverence. The earlier discussion attests to the fallaciousness of this concept.

Today it is generally unrefuted that in routine checks of sanitary water quality, where the approximate value of the bacterial density is known or can be determined, the most effective technic is obtained by inoculating all tubes at a single dilution, the volume of the dilution and the number of tubes being chosen so that the probability of obtaining a proportion of positive tubes which will result in rejection of the supply will be small when the density is within the customary range; and very large when the bacterial density is outside this range. Further, when the approximate bacterial density is unknown, several tubes should be inoculated at each of a series (geometric, in ascending powers of 10).

Status of MF Technic

Although the principles and technics of membrane filtration cannot be considered the *ne plus ultra* in achievement, application of this control test in sanitary bacteriology can help to minimize the misconceptions and greatly reduce the elements of uncertainty of the MPN coliform index.

Pros and Cons

Some investigators have been unable to account for the disparity in coliform recovery between the MPN and the membrane filter technics. Although the significance of the difference between the biological populations identified by the two tests, if any, remains to be determined, much of the disparity in quantitative results can be attributed to bias inherent in the derivation of MPN's. Thus, the disparity is more apparent than real. In comparing the relative merits of the two technics, Thomas and Woodward[11] estimated that the precision obtained with a single filter is from two to five times greater than that of a 5-5-5 tube MPN.

Aside from statistical and probability considerations discussed previously, another weakness of the tube test method is the fact that it is so relatively laborious, complex and time-consuming that catholic application is largely prohibitive. The expenses involved in the mailing of samples, losses, breakage, etc., and in the laboratory examination itself, have considerably limited the areas for which bacteriological quality control is feasible.

Membrane filter investigators have demonstrated a substantial reduction in time, expense, material, equipment, and labor requirements. Moreover, when the test is properly employed, they have suggested the probability that errors in personal judgment are perceptibly minimized, and that the results surpass in certainty, accuracy, and duplicability, those that heretofore have been possible for tube tests applied within the obvious limits of practicability recognized by "Standard Methods."[9]

Summary

Twenty years ago Hoskins[4] asserted that ". . . it seems reasonable to conclude that the dilution tube method cannot result in an accurate enumeration of coli-aerogenes organisms and that, therefore, the need for an acceptable and dependable method still remains." He added further that ". . . if correspondingly as much study (as the MPN) were devoted to the development of a suitable plating phase of coli-aerogenes enumeration, it is quite reasonable to believe that this effort would yield a method superior to the present one."

The principal, often unrecognized, weaknesses and inherent limitations of the MPN index of coliform density which contributed to Hoskins[1] observation have been reviewed. Though MPN's have dubious value, especially on certain types of water, until the advent of the membrane filter technic they were recognized as most nearly approaching the ideal coliform index. Current indications are that the membrane filter technic more closely fulfills the desired requisites and that it represents a closer measure of the true coliform density of a sample.

It is anticipated that further refinements leading to routine utilization of the membrane filter as an in-place test to complement the sanitary survey will satisfy the exigent need for more frequent and representative hygienic control of the environment than has ever before been realized.

References

1. Georgia, F. R., "Evaluation of Coliform Organisms in Water." *Jour. A.W.W.A.*, 34:4, 577-584 (1942).
2. Gordon, R. D., "Note on Estimating Bacterial Populations by the Dilution Method." *Proc. Nat'l. Acad. Science, U. S.*, 24: 212-215 (1938).
3. Greenwood, M., and Yule, G. U., "On the Statistical Interpretation of Some Bacteriological Methods Employed in Water Analysis." *Jour. Hygiene*, 16: 36-54 (1917).
4. Hoskins, J. K., and Butterfield, C. T., "Determining the Bacteriological Quality of Drinking Water." *Jour. A.W.W.A.*, 27:9, 1101-1109 (1935).
5. McCrady, M. H., "The Numerical Interpretation of Fermentation Tube Results." *Jour. Infec. Dis.*, 17: 183-212 (1918).
6. Pomeroy, Richard, "Statistical Treatment of Bacterial Data." *Sewage and Indus. Wastes*, 27:1, 85-92 (1955).
7. U. S. Pub. Health, "1946 Drinking Water Standards." U. S. Gov. Printing Off., Washington, D. C.
8. Reed, J. L., "Report of Advisory Committee on Official Water Standards: *B. coli* Densities as Determined from Various Types of Samples." *Pub. Health Reports*, 40:1, 704-716 (1925).
9. "Standard Methods for the Examination of Water, Sewage and Industrial Wastes." Tenth Ed. Amer. Pub. Health Ass., New York. (1955).
10. Thomas, Harold A., "Statistical Analysis of Coliform Data." *Sewage and Indus. Wastes*, 27:2, 212-222 (1955).
11. Thomas, Harold A., and Woodward, Richard L., "Estimation of Coliform Density by the Membrane Filter and the Fermentation Tube Methods." *Jour. A.P.H.A.*, 45:11, 1431-1438 (1955).

As additional material to add to current information on the subject here is a discussion of T. F. Wisniewski's article . . .

Algae and Their Effects *on D.O. and B.O.D.*

by DR. A. F. BARTSCH, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Part III

EDITOR'S NOTE: In the two previous issues *Water & Sewage Works* published Parts I and II of an article on this subject by T. F. Wisniewski, Director of Stream Control Commission of the State of Wisconsin. The article contained detailed studies on this important phase of stream pollution. In Part III, here, Dr. Bartsch discusses the Wisconsin studies in light of experimental studies at the Robert A. Taft Santary Engineering Center. Both the orginal paper and the discussion were presented at the Seminar on Oxygen Relationships held at the Sanitary Engineering Center.

■ THE INFORMATION presented in the original article on "Algae and Their Effects on O. and B.O.D." (Parts I and II) represents an interesting new approach to a problem that has been neglected for a long time. It seems appropriate that this work reported by T. F. Wisniewski* should have been done in Wisconsin, because in that state especially there has long been an interest in algae as they relate to artificial eutrophication involving sewage plant effluents, chemical algal control, and effects of algae on stream conditions. There is reason to believe that water resource problems accompanying intense algal production will grow in prominence throughout the country as levels of available algal nutrients increase and many water areas become improved algal habitats as a result of impoundment.

Mr. Wisniewski pointed out that there are two principal areas of algal influence on which better information is needed; the part algae play in determining the assimilation capacity of streams, and the effect of algae present in the sample upon the laboratory BOD. Field and laboratory data are presented in reference to both areas of interest.

Although the Fox River in Wisconsin apparently brought the algal prob-

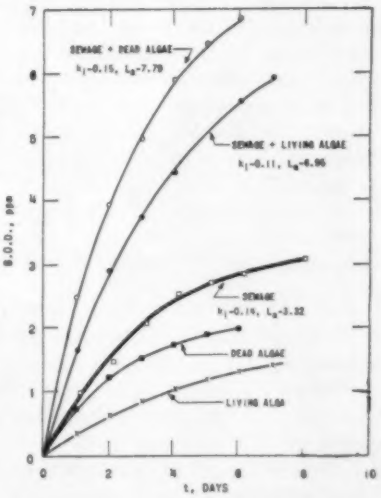


FIG. 1—Influence of algae on B.O.D.

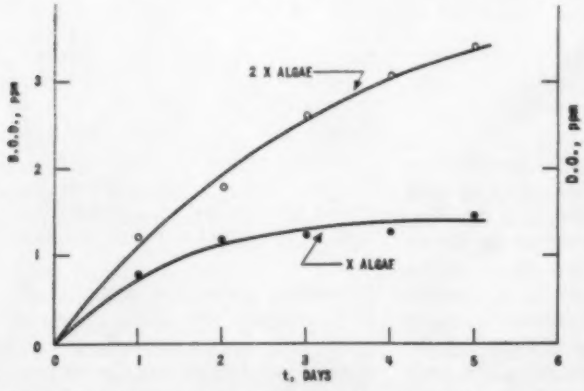


FIG. 2.—Influence of quantity of algae on B.O.D., Aug. 26, 1955.

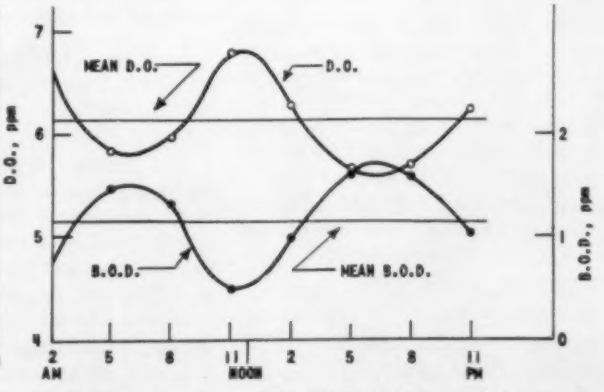


FIG. 3—Influence of diffused daylight on B.O.D. sample containing algae, Aug. 26, 1955.

lem into sharp focus because of the large tonnages of algae entering it from Lake Winnebago, this type of situation is not typical of that usually found in rivers. Here, the algae reaching the river originated in a different type of habitat, are less suited to existence in the river, and die off downstream. In October 1946 a more intensified situation of this kind occurred in the Yahara River in Wisconsin where tremendous quantities of algae entered from Lake Kegonsa, decomposed in passing downstream, and caused oxygen depletion with resulting death of tons of fish.[1]

More commonly the algae in rivers are less numerous than in the two situations cited. Moreover, algae found in rivers typically are produced therein and therefore are in closer harmony with that type of habitat. They are likely to affect both the oxygen relations in the stream and the course of the BOD reaction with less violence than under the circumstances cited in these previous cases.

Results of limited studies at the Robert A. Taft Engineering Center are generally in close agreement with the Wisconsin results. They are presented in reference to the same questions stated by Wisniewski, as follows:

1. What influence, if any, does the presence of algae have on the laboratory BOD determination?

In one case, this question has been approached by removing algae from samples and comparing the BOD response with that of samples containing algae. Unaltered samples from waste stabilization ponds commonly have BOD of about 25 ppm, whereas others that have been filtered to remove the algae have values between 6 and 7 ppm. Another approach has been to add known quantities of algae *(Chlorella variegata)* to samples made up with 0.5 per cent settled sewage and then determining the BOD in the standard manner. Figure 1 shows the course of the BOD reaction with a sample containing 1,200,000 cells per milliliter. The algal cells contributed to the total BOD to the extent of about 0.2 ppm per million cells.

2. What influence, if any, do increasing amounts of algae have on the laboratory BOD value?

To obtain information on this question, BOD samples were prepared so that one contained the phytoplankton removed from 20 volumes of Ohio River water, the other the quantity removed from 40 volumes. These are noted as "x algae" and "2x algae" in Figure 2, which shows, as does the Wisconsin work, that increasing amounts of algae result in increasing BOD. When dead *Chlorella* cells from laboratory cultures were added to samples in relative quantities of 1, 10, and 66, the resulting BOD values were 3.21, 3.73, and 7.74 ppm, respectively. A similar result occurred with living cells. These results agree with the Fox River data, which show that BOD concentrations increase with increasing suspended solids, largely algae, in the sample.

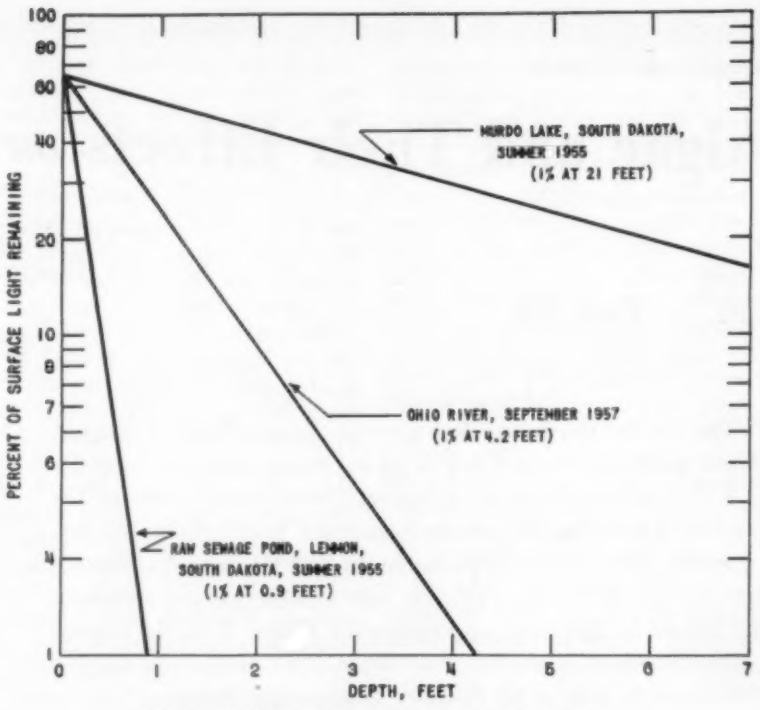


FIG. 4—Light penetration through natural waters.

3. What difference occurs in oxygen usage rates between samples containing algae and incubated in the dark and the light?

The influence of algal photosynthesis on the BOD of samples incubated in the light is well shown by the Wisconsin data. With continuous illumination, there was generally an excess of DO in the sample. It is also important to follow the fluctuating course of the DO levels, and therefore the indicated BOD also, when the samples are exposed to the daily changing light intensities found in nature.

Results of such exposure are shown in Figure 3 for a sample containing Ohio River algae. When replicates were incubated in the dark for 19 hours the mean BOD was 2.77 ppm; but with natural light it was only 1.15 ppm. Furthermore, if all the samples had been processed at noon, the mean BOD of the illuminated samples would have been 0.55 ppm, but that of the ones in the dark would have been 2.10 ppm—a difference of 400 per cent. Obviously, incubation in neither continuous light nor continuous darkness can yield very instructive results in relation to natural conditions in streams.

4. What influence, if any, does the presence of dead or decomposed algal cells have on the BOD determination?

Samples from the Fox River were processed to determine the influence of dead cells. July samples that were autoclaved to kill the algae showed a decreased rate constant, whereas September samples had an increased constant as compared with unautoclaved material.

Figure 1 shows the course of the BOD reaction with living algae, together with that for the same quantity of algae killed by raising the temperature to 70C. It was concluded from the Wisconsin work that autoclaving

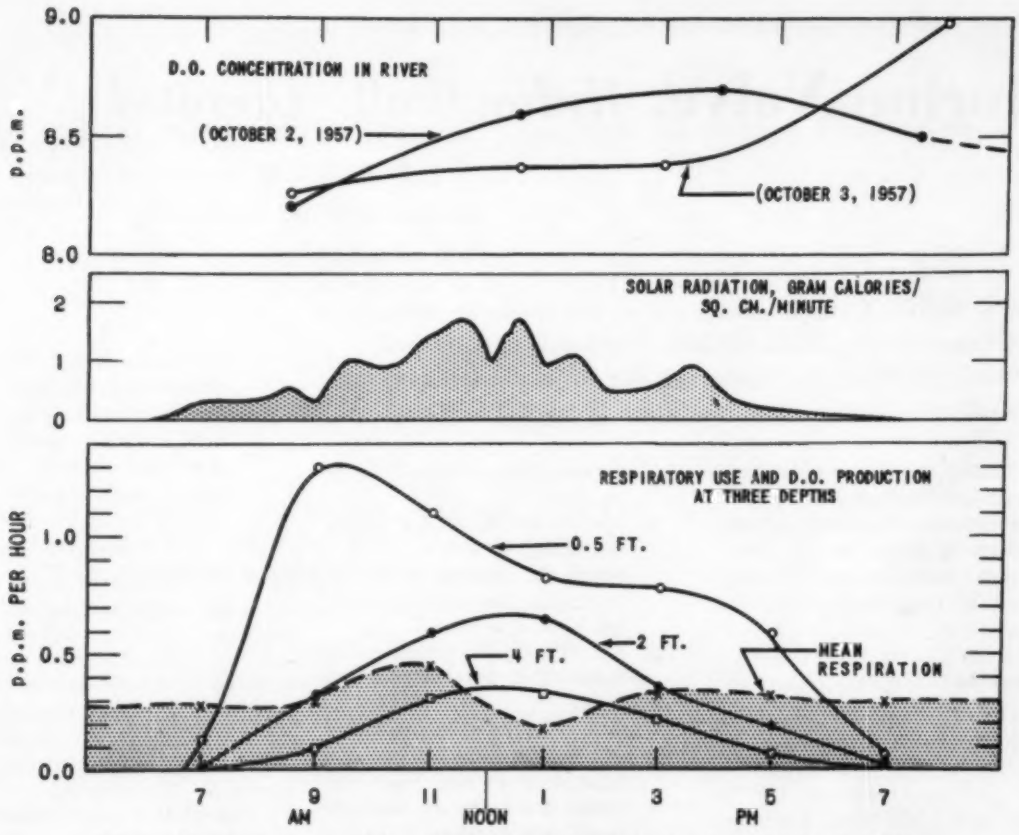


FIG. 5—Dissolved oxygen relations in Ohio River (Reach 11, Bromley), October 3, 1957.

the samples (that is, having dead algal material present) does not greatly affect the ultimate BOD. This is suggested to some extent by the curves in Figure 1 also. It is agreed that the slow oxygen consumption in algal respiration is no greater than aerobic bacterial oxidation of dead algal cell material.

Various approaches have been made to assess the influence of algal photosynthesis upon DO resources in streams. In the Wisconsin work this was done through use of "instructive" BOD's such as those described. Another approach is that of Odum,[2,3] which interrelates existing oxygen concentration, provision of oxygen from inflow, atmosphere and photosynthesis, and loss through total respiration. A third approach involves the use of "light and dark bottle" tests to measure photosynthesis and respiration simultaneously.

Because, in general, all appreciable photosynthesis occurs in the surface layer, which absorbs 99 per cent of the light (euphotic zone), it is important to measure and evaluate water transparency in connection with oxygen relations. This characteristic may vary widely, as indicated by Figure 4, which shows light penetration in three bodies of water. In the euphotic zone of the Ohio River on October 3, 1957, light and dark bottle tests indicated oxygen production of 57 pounds per acre per day and respiratory use of 45 pounds per acre per day—a P/R ratio of 1.5.

As shown in Figure 5, the rate of oxygen production varies with time of day in relation to momentary intensity of solar radiation and decreases also with depth in response to impaired light penetration. The influence of photosynthesis on DO concentration in the river was obscured by an abnormal flow pattern on October 3. Conditions shown for October 2 were more typical. Similar tests in a raw sewage pond at Lemmon, S. Dak., on August 10, 1955, showed production of 183 pounds and respiratory use of 130 pounds per acre per day—a P/R ratio of 1.4.

It is apparent from these ratios that the oxygen provided by algal photosynthesis is not a free gift obtained at no cost. As long as P/R ratios are in the neighborhood of 1.5, high daytime oxygen production by dense algal populations will be accompanied by rapid respiratory use that persists around the clock. In rivers this typically results in mild nocturnal depressions in DO, but in sewage ponds it may bring about oxygen exhaustion lasting several hours.

Acknowledgment

The writer wishes to acknowledge the continuing efforts of his fellow workers, E. C. Tsivoglou, W. M. Ingram, T. E. Maloney, and D. G. Ballinger, in connection with this subject.

References

1. Mackenthun, R. M., Herman, E. F., and Bartsch, A. F., "A Heavy Mortality of Fishes Resulting from the Decomposition of Algae in the Yahara River, Wisconsin." *Trans. Amer. Fish. Soc.*, 75:175-180. (1945, publ. 1948).

2. Odum, H. T., "Primary Production in Flowing Waters." *Limnology and Oceanography*, 1:102-117 (1956).

3. Odum, H. T., "Primary Production Measurements in Eleven Florida Springs and a Marine Turtle-Grass Community." *Limnology and Oceanography*, 2:85-97 (1957).

Simple redesign of a Mueler pressure valve offers a rugged, safe . . .

Chlorine Valve, *Hydraulically Operated*

by J. R. ROSSUM, Sanitary Engineer,
California Water Service Co.
San Jose, Calif.

EDITOR'S NOTE: A simple conversion of any manually operated chlorinator to semi-automatic operation, has been developed by the California Water Co. by the use of a hydraulically operated shut-off valve, the description of which is detailed here.

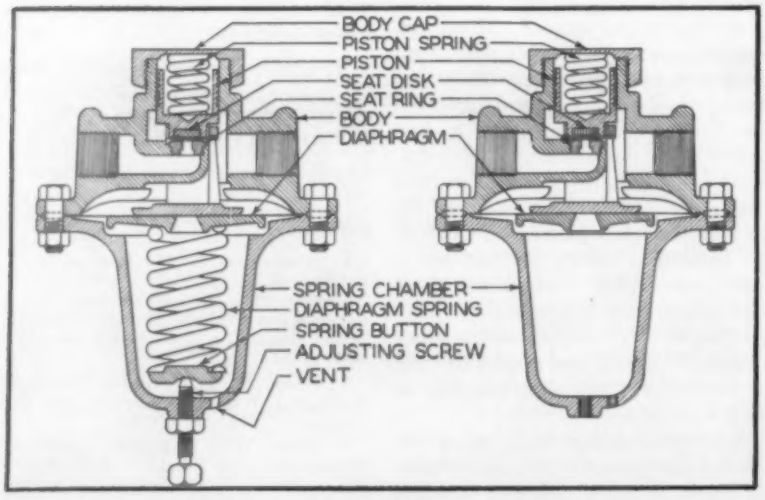
■ THIS DEVICE was designed to start and stop chlorinators on wells where the water pressure downstream from the check valve drops to zero when the well is not operating, and increases to at least 20 psig when the well is operating.

Method of Redesign

The chlorine shut-off valve is a modified Mueler pressure reducing valve, Type H-9013, size ⅜-in. for 150-300 psi inlet pressure. It is equipped with a No. 51607 seat ring, having an orifice 0.160-in. diameter as shown in the accompanying figure.

To modify the valve, the following steps are taken:

1. Disassemble.
2. Replace the rubber seat disk with a Teflon disk cut from ⅛-in. Teflon sheet with a cork borer.
3. Replace the top bronze diaphragm with a sheet of 0.005-in. silver.
4. Discard the diaphragm spring and spring button.
5. Retap the threads which accommodate the adjusting screw for ¼-in. iron thread.
6. Seal the spring chamber by inserting a plug in the vent hole.
7. Assemble the valve with lead gaskets, cut from 1 lb per sq ft lead sheet to seal joints between the body cap and the body and between the silver diaphragm and the body.
8. Attach the desired chlorine fittings to the inlet and outlet ports using appropriate bushings. All threaded joints for chlorine will require litharge and glycerine paste.
9. Attach a fitting to the spring chamber for connection to the actuating water source.
10. Test each valve for bubble tight closure and for leaks before use. If the valve is not bubble tight, a shim is inserted on top of the piston spring. (A penny usually makes a satisfactory shim)



CROSS-SECTION of chlorine shut-off valve.

Valve Operation

During operation, the piston spring holds the Teflon seat disk against the seat ring with considerable force. The valve opens when water pressure is applied to the spring chamber lifting the seat disk. Water pressure of at least 20 psig is required for reliable operation. The chlorine pressure on the downstream side of the valve is maintained at about 10 psig less than the actuating water pressure which helps eliminate the possibility of liquifaction of chlorine in the chlorinator.

About 15 of these valves are in service and have been operating for periods up to five years. Some are on wells that are used occasionally and others are used on wells throughout the year. The wells are operated by time clock, pressure switch or other automatic device so that many of the valves are required to operate several times each day. Several makes and models of chlorinators have been used ranging in capacity from less than 5 to more than 100 lb of chlorine in 24 hours. During this period, three valves have failed to function, and in each instance failure has been caused by a deposit of a waxy material which freezes the piston in either the closed or open position. All three of these failures occurred at about the same time so that it is presumed that they were caused by a particular shipment of chlorine rather than by a slow accumulation of impurities over a period of about four years. The waxy material was easily removed with the usual solvents, and careful inspection failed to show any evidence of serious wear.

With the development of a vast highway system comes the need for sewage treatment at . . .

Turnpike Service Areas, where high rate trickling filters are found to be advantageous

By W. F. MIDDLETON, Engineer, Chas. W. Cole & Son, South Pond, Ind.

RESUME: In this article, presented by Mr. Middleton, at the 21st meeting of the Ind. Sew. & Ind. Waste Assn. the author reviews the studies made of design requirements, the selection of the desired treatment process, and plant operating results for service area sewage treatment along a major arterial highway route. An interesting phase of his report is the beneficial use of pre-digestion for installations of this type.

■ IN THE early fall of 1954 Chas. W. Cole & Son was retained by the Indiana Toll Road Commission to design and supervise the construction of the Service Area Facilities for the Northern Indiana East-West Turnpike. Many questions concerning basic design data applicable to the various phases of the work soon arose in the minds of those responsible for a specific phase of the design.

In 1954, although many Turnpike Projects were in the preliminary planning, final design or construction stage, only two with major service area facilities, the New Jersey and Pennsylvania Turnpikes, had been completed and were in operation.

Of these two, the New Jersey Turnpike had been in operation about two years; the east and west extensions of the Pennsylvania Turnpike had been in service about the same length of time. The older Section of the Pennsylvania Turnpike, from Harrisburg to near Pittsburgh, had been in service about fourteen years. Needless to say, all designers drew heavily on the operating experience of these two roads to substantiate, or modify, any preconceived theories they may have had concerning the proper design of the various facilities.

Decisions regarding traffic flows and patterns, translated into favorable Service Area locations, together with the necessary extent of restaurant and service station facilities were made by experts in these fields. With one exception, the sites selected were miles from a receiving stream of any size, or were adjacent to posted trout streams, recreational areas, or streams used as a source of water supply for a downstream community. Obviously, treatment of a high order was required at all locations.

Turnpike Operating Records

Study of operational records from the Pennsylvania and New Jersey Turnpikes indicated that, in the initial design of Service Area sanitary facilities for each of these turnpikes, the difference between wastes to be treated from Service Area restaurants and ordinary domestic sewage was not fully appreciated. The problem of Service Area Wastes is complicated and requires methods and facilities much different from those commonly provided for the treatment of domestic sewage. Since, in these installations, the problem was new, many mistakes were made which have, over the past several years, been corrected.

Data obtained from the above mentioned operating records indicated that the liquid waste to be treated from Service Station restaurants is preponderantly food preparation waste water drained from the kitchens, dairy bars and soda fountains and the waste water from washing of dishes and utensils. Kitchen wastes are high in temperature. Maximum discharges occur during periods of cleaning utensils and dishes.

Sanitary sewage from the washrooms and toilet facilities is lower in quantity and strength than that discharged from the kitchen. It is usually low in solids content, but high in soap and urine. Temperatures are only slightly greater than the temperature of the potable water supply. The combined kitchen and sanitary waste averages 500 to 550 mg/L B.O.D., 150 to 200 mg/L suspended solids, 75 to 100 mg/L grease and approximately 100 mg/L active detergents. Temperatures of the combined wastes varied from a minimum of 55°F to a maximum of 130°F. Delivered to a common sedimentation basin the average comes within the range of 70° to 85°.

Anticipated Flows

The anticipated flow from each Service Area was established utilizing operating experience from the Pennsylvania Turnpike. Food sales, the yardstick for estimating the waste to be disposed of, showed a greater seasonal variation than the number of vehicles using the Turnpike. For example, in August, 1957, vehicular traffic was 150 per cent of the yearly average but food sales for August were 165 per cent of the yearly average. Vacation traffic and number of occu-

pants per vehicle were apparently responsible for the larger summer food sales. In addition to the seasonal variation there existed holiday peaks, extreme winter weather lows and unpredictable traffic loads which occurred at Service Areas at odd times. Experience indicated that extreme peak flows run from two to three times the yearly average, and extreme low flows from practically nothing to 30 or 40 per cent of the yearly average daily flow. It was also found that water consumption and liquid wastes followed food sales and, approximately, the traffic pattern.

Yardstick Developed

A convenient yardstick for predicting total sewage flows was developed from the New Jersey and Pennsylvania data and is based upon flows in gallons per day per dining room or counter chair. An average flow of liquid waste of 150 gallons per day per dining room chair and 350 gallons per day per counter chair may be anticipated. New Jersey Turnpike experience yielded up to 2000 gallons per day per chair, but this figure was not used as the New Jersey Turnpike reached the twenty-year design capacity about two years following completion date.

The next question to be settled prior to the final design of the Indiana Toll Road Service Area sewage treatment facilities was the type of plant which would effect a high degree of removal for a sewage having the characteristics and quantities anticipated. Again operating experience on the Pennsylvania and New Jersey Turnpikes was drawn upon. Original installations on the Pennsylvania Turnpike consisted almost entirely of septic tanks and sand filters. All these treatment plants soon became fouled, due to the heavy grease loading, and have since been replaced with high rate filtration plants, or by discharging the raw sewage into nearby municipal sewage treatment plants.

The original installations on the New Jersey Turnpike consisted of septic tanks and covered leaching sand filters or tile fields. These installations also failed due to heavy accumulations of grease and have been or are now being replaced by low rate trickling filters.

Pre-digestion Utilized

One of the interesting developments in the replacements made in the Pennsylvania Turnpike was the provision of pre-digestion facilities in the Valley Forge treatment plant. Although long range results were not obtainable in 1954-55, the preliminary results of this installation were most promising. In this method all raw sewage first enters the digester, and after retention to the capacity of the digester, is then discharged to the sedimentation tanks followed by the usual secondary treatment units.

"The problem of service area wastes . . . requires methods and facilities much different from those commonly provided for municipalities."

Preliminary results at Valley Forge indicated that B.O.Ds. were reduced in the digester from 500 mg/L to about 130 mg/L; that grease, soaps and detergents present in the waste were broken down, thereby eliminating possible trouble in the secondary units; that all obnoxious grease and floating materials are initially diverted to digestion thereby keeping the sedimentation unit clean and free of floating solids; that pre-digestion eliminates the possibility that grease and scum carried down by the hot waste will turn septic, or rancid, and give off foul odors. All conditions at the Service Areas were favorable to the pre-digestion process, particularly the temperatures at which the raw waste arrived at the plant.

Site Description

The Northern Indiana Turnpike consists of dual east and west lanes divided by a median strip. The Service Area Sites, eight in number, are spaced approximately fifteen to twenty miles apart. The sites include an area averaging about 1200 by 1200 feet. Each area is bisected east to west by the road proper leaving on both the north and south sides an area of 450 by 1200 feet which is utilized for the acceleration and deceleration lanes, approach ramps, gasoline and diesel fuel pumps, service station, restaurant, novelty shop and rest room facilities. The facilities are centered on the 1200 foot dimension. The remaining area available for water supply and treatment, and sewage treatment facilities consists of four roughly triangular pieces, having legs of about 300 x 300 feet, located at the outermost corners of the property, and less than 400 feet from the restaurant facilities.

Due to this proximity and limited space, the following features became axiomatic in the design of the sewage treatment facilities: sightliness, flexibility of operation, freedom from odors and flies, and amenability to good housekeeping procedures.

Of the eight Service Areas for which sites had been acquired and brought to grade only five were to have facilities constructed upon them in the initial program. Beginning at the west end of the Road these Areas were Number 1, just east of Gary; Number 3, about three miles north of Rolling Prairie; Number 5, about two and one-half miles north of Elkhart; Number 7, about six miles northeast of Howe; and Number 8, about seven miles northeast of Angola.

The receiving stream available for discharge of treated wastes at Area Number 1 is approximately 1300 feet west of the Area west property limits. Dilution was adequate, but a fairly high degree of treatment was required since the stream traverses a heavily populated area.

At Area Number 3 no receiving stream was available for the treated effluent. Hog Lake, immediately adjacent to the west property limits, is a highly developed recreational area and was excluded from consideration as a point of direct discharge. Fortunately a pot hole, forming a depression about forty feet deep and having a bottom area of about four acres was located about 900 feet southwest of the southwest corner of the Area property. It was decided to use this pot hole as a ponding area for the treated effluent since no direct connection existed between the hole and Hog Lake. Although the pot hole was screened from view by a heavy growth of trees a very high degree of treatment was required at this site to prevent nuisance conditions developing in the ponding area and undesirable odors returning to the Service Areas.

At Service Area Number 5 two potential receiving streams were available. About one mile east of the Area flows Christyann Creek, a source of water supply for the City of Elkhart, and consequently eliminated from consideration. Approximately two and one-half miles west a minor stream

"The decision was . . . to provide an identical design for a basic sewage treatment plant for all areas."

was available. Considerations of cost and desirability finally dictated that the raw sewage from this Area be discharged into the Elkhart sewer system for treatment at the Municipal Plant. Construction of a pump station and about three miles of combination force main and gravity sewers were required to deliver the raw sewage to the Elkhart system.

At Service Area Number 7 the only available receiving stream was located about two and one-half miles west of the Area. This stream, an outlet for Cedar Lake which is a highly developed recreational area, had a very low flow during dry weather. In addition, the stream was a posted trout stream. The receiving stream conditions dictated that an extremely high degree of removal was required at this Area.

At Service Area Number 8 two streams were available, one of which had its source in springs located near the southwest corner of the Area. A short distance downstream it discharges into a posted trout stream and eventually into Marsh Lake and then James Lake, a highly developed recreational area. At the southwest corner, a stream having a substantially higher flow also passes the service Area. This stream also discharges into Marsh Lake and James Lake. This latter stream was selected as the receiving stream, again requiring a very high degree of treatment.

Restaurant facilities were divided into two classifications A and B. Class A restaurants were to provide 104 dining room seats, 32 booth and 36 counter seats. Class B restaurants were to provide 56 dining room, 16 booth and 18 counter seats. North and South facilities for each Service Area were to combine Class A and B restaurants as follows: Service Area 1, one Class A and one Class B; Service Areas 3, 7 and 8, two Class B; Service Area 5, two Class A restaurants and a commissary.

Design Flows

Applying the previously developed yardstick of 150 gallons per day per dining room chair and 350 gallons per day per booth and counter chair yielded total yearly average daily flows per Area ranging from 61,000 gallons per day for the smallest installations to 100,000 gallons per day for the Elkhart installation, including the Commissary wastes.

Since the small restaurants easily could be expanded, it was decided to use the 100,000 gallons per day figure as the basis of design for all Areas. To maintain a high degree of removal during extended periods of exceptionally high waste flows, the 100,000 gallon per day figure was arbitrarily increased twenty-five per cent to 125,000 gallons per day. The decision was also made to provide an identical design for a basic sewage treatment plant for all Areas, varying the design only as required by the topography of each Site, and including additional treatment units only at sites where receiving stream conditions required further treatment.

For the final design flow to each plants the following criteria were established, based upon previous turnpike data and tempered by local requirements.

5 day—20°C BOD	500 mg/L
Suspended Solids	400 mg/L
Restaurant garbage grindings included.	
Fats	100-130 mg/L
Detergents	100 mg/L
Ave. Yearly Daily Flow	125,000 gpd
Max. Daily Flow	200,000 gpd
Min. Daily Flow	30,000 gpd
Max. Hydraulic Capacity	450,000 gpd
BOD Removal	90 per cent at the maximum daily flow to 97 per cent at the minimum daily flow.

The plant design required almost complete removal of settleable and suspended solids, fats and detergents.

The type of treatment process for the basic Service Area sewage treatment plant now remained to be decided upon before the final design, plans and specifications could be prepared.

Sand filters without extensive prior treatment of the applied sewage, were immediately excluded from consideration as the result of previous Turnpike operating experience. Low rate trickling filters also were excluded from consideration due to the heavy concentrations of filter flies inherent to this process, limited space available and proximity of the restaurant facilities. The activated sludge process also was rejected due to inherent sensitivity to shock loads, need for constant skilled operation, and the certainty that extensive and annoying foaming would occur on the aeration units due to the heavy concentration of grease and detergents anticipated in the raw sewage.

Process Selected

In short, a treatment process which would very nearly run itself, except for good housekeeping measures and care of equipment, was desired. The high rate trickling filter process, employing a constant recirculation flow rate regardless of the raw sewage flow, was selected for the final design of the basic sewage treatment plant for the Service Areas. The final design of the plant included the following units: comminutors, lift station, separate sludge digestion, primary, intermediate and final sedimentation tanks, two stage high rate filters and recirculation pumps. All units were designed in accordance with the Ten-State Standards.

Facilities for pre-digestion were provided for use in the event predigestion proved advantageous as an operating procedure. This required provision of two speed motors for the three raw sewage pumps to overcome the additional head required to pump the raw sewage into the digester. Predigestion also required additional piping from the pump discharge header to the digester with an automatically controlled butterfly valve installed in a return or overflow line from the digester influent box to the wet well. In this manner raw sewage entering the digester was equal to the influent raw sewage flow, thereby eliminating slugs or surges entering the digester and creating an undesirable turbulence in the digester.

Another feature not usually found in plants of this type is the provision of a degreasing chamber preceding the primary sedimentation tank. This chamber serves a triple purpose. During normal or standard operation for this type of plant the chamber also provides pre-aeration during normal or high flows. During low flow periods a portion of the filter effluent may be returned to the chamber and reaerated before entering the primary sedimentation tank to prevent septicity due to an extended detention period. When pre-digestion is practiced the digester effluent also may be pre-

aerated in the degreasing chamber prior to discharge to the sedimentation tanks.

> *". . . A treatment process which would very nearly run itself . . . is desirable."*

Units Covered

The high rate filter units were covered to eliminate leaves or debris from collecting on the surface of the filter stone and to eliminate spray from icing adjacent roads. This required up draft forced ventilation since throughout most of the year the applied sewage is warmer than the surrounding air.

Since the filter recirculation flow rate is constant, the recirculation ratio for each filter varies from .88 to 1 for the maximum daily flow to as high as 11 to 1 for the minimum daily flow. The recirculation ratio is 2 to 1 for the yearly average daily flow of 125,000 gallons.

Interior piping is so arranged that a conversion from standard operating to pre-digestion procedure is readily accomplished in a minimum of time. A common header channel serving all sedimentation tanks is so arranged that any one tank may be removed from service while leaving the other two tanks in service. Three recirculating sumps and pumps are provided. The center sump and pump serves as a spare which can be used to substitute for either the primary or secondary filter pumping facilities. A single chlorinator, installed in a separate room, provides pre- and post-chlorination and chlorination of each filter influent.

Two sand filters are provided at Service Area Number 7. The effluent from the basic treatment plant is repumped to a siphon chamber centered between the two filters. Two siphons alternately discharge the treated sewage to each filter through rotating distributor arms.

The exteriors of all treatment units are designed to harmonize with the architectural features of the service buildings. Interior walls of the control building above grade are glaze tile lined. All units above and below ground are readily accessible, facilitating cleaning and good housekeeping measures. Each plant is equipped with a laboratory table and equipment for making simple tests including settleable solids and dissolved oxygen.

Sludge

Under normal operating conditions digester sludge is pre-heated. The sludge pre-heater also provides building heat. During pre-digestion operation the pre-heater is used only to provide building heat. Digested sludge is discharged directly to a 1000 gallon tank truck acquired by the Toll Road Commission. The truck is equipped with a spray bar used to spray the wet digested sludge on grassed areas of the Service Areas and the Toll Road. Accumulations of grease, both from the plant and from grease traps provided at each kitchen and at the Commissary, are also discharged into this tank truck. The grease is disposed of by burying at selected points along the Road.

With the exception of digested sludge withdrawal and grease disposal, the operation of the plant is entirely automatic once the operating procedure is established. At each Service Area one man attends both the water treatment and sewage treatment plants eight hours a day, seven days a week. His time is spent mainly in housecleaning, maintenance, and servicing of equipment. The plants run without any superintendence the remaining sixteen hours of each day. None of the operators had previous experience in operating a sewage treatment plant.

The ability of the plants to absorb shock loadings was demonstrated early when the Contractor returned to repair digester leaks at Areas 7 and 8. Several months accumulation of partially digested sludge and supernatant liquor were dumped into the sedimentation tanks within a few hours. Even under this treatment the plant maintained an acceptable effluent and had fully recovered within a few days.

Operating Results

These plants have passed through summer peak flows very satisfactorily. High quality effluents are maintained at all plants and no complaints have been received concerning odors or nuisances at the Service Areas, along the receiving streams, or from the ponding area at Service Area Number 3. Up to this time, the pre-digestion features incorporated in each plant have not been used as results have been satisfactory under standard operating procedure. Grease or detergents have not been a problem in plant operation, being successfully removed by the kitchen grease traps, and the plant de-greasing chamber.

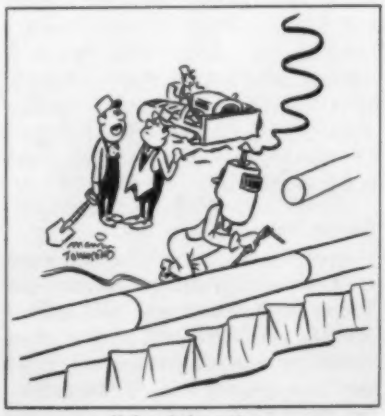
Illinois Water Rights Law and What Should Be Done About It

The Illinois State Chamber of Commerce, in 1956, through it's Water Resources Committee, authorized an extensive research project to determine what state legislation if any, should be recommended to correct the drought problems of 1952-1955.

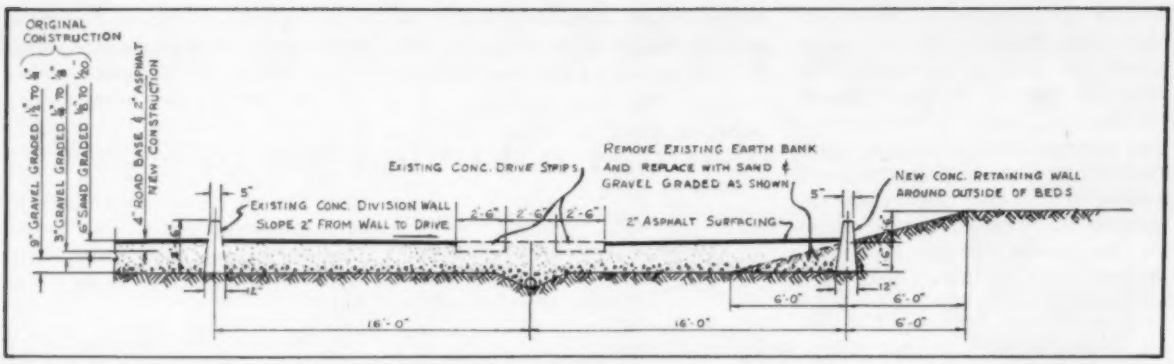
John E. Cribbet, Professor of Property Law, College of Law, University of Illinois was then employed to make a study of the vastly increased demands on the state's limited water resources, and the current water rights laws applicable.

After a year-long research effort, Professor Cribbet submitted this report to the committee. The committee then incorporated into the report the conclusion drawn from it by the committee and the Board of Directors of the Illinois State Chamber of Commerce.

Copies of this very comprehensive research report and the recommendations for the future development Illinois water law are available from the Water Resources Committee, Illinois State Chamber of Commerce, 20 North Wacker Drive, Chicago 6, Ill., for $1.00 per copy.



He's a chain smoker.


ORIGINAL CONSTRUCTION
8" GRAVEL GRADED
3" GRAVEL GRADED
6" SAND GRADED
4" ROAD BASE & 2" ASPHALT NEW CONSTRUCTION
EXISTING CONC. DRIVE STRIPS
REMOVE EXISTING EARTH BANK AND REPLACE WITH SAND & GRAVEL GRADED AS SHOWN
NEW CONC. RETAINING WALL AROUND OUTSIDE OF BEDS
EXISTING CONC. DIVISION WALL
SLOPE 2" FROM WALL TO DRIVE
2" ASPHALT SURFACING
16'-0"
16'-0"
6'-0"
6'-0"

CROSS SECTION through bed shows construction details that enable faster drying times, lower maintenance and operating costs to be realized by the use of—

Asphalt Paved Sludge Beds, *in Salt Lake City*

by WILLIAM T. SOUTH, General Manager, Suburban Sanitary District, Salt Lake City, Utah

EDITOR'S NOTE: Mr. South first became interested in the use of Asphalt paved sludge beds after he received a drawing from Guido G. Coppa, Supt. Sewage Treatment Plant, Concord, Calif., showing a profile of the beds used in Concord, and presents here the success of Salt Lake City's adaptation and construction details of this type of sludge bed.

■ THE SEWAGE TREATMENT plant for the Salt Lake City Suburban Sanitary District was put in operation in October, 1955. It was designed to serve a population of 40,000 people. There are twelve sludge beds, 125 feet long by 32 feet wide in two banks of six each. Originally the drying area was constructed with a coarse gravel base, then a layer of finer gravel with six inches of fine graded sand on the surface. A sub-drain extended the length of the beds between the drive strips at the base of the course gravel.

The operation and maintenance of this type of bed is relatively costly as it is almost impossible to use power equipment to remove the sludge without damaging the bed and cleaning and replacement of the filter sand is a perpetual problem. Plant operators inform us that the hand shoveling of sludge is one of the more undesirable tasks in their plant maintenance program.

Construction Details

Therefore, it was decided to experiment with one bed at our plant. In June of 1956 one bed was converted by removing the six inch layer of filter sand throughout the entire bed except between the drive strips. This was replaced with a four inch layer of compacted road base and a two inch surface of compacted ¼ in. minus asphalt plant mix. On this bed a slope

Table 1
Drying Times

1956	Asphalt Bed	Sand Bed
August 3	Sludge drawn	Sludge drawn
August 13	No apparent difference on either bed	
August 18	Bed 85% dried	Bed 65% dried
August 22	Bed 100% dried and sludge removed	Bed 80% dried
September 1		Bed 100% dried and sludge removed

Table 2
Comparative Costs of Maintenance and Operation

Removal of sludge	Asphalt Bed hr.	Asphalt Bed Tot. Cost	Sand Bed hr.	Sand Bed Tot. Cost
Labor	--	------	28	$56.00
Power loader	2	$12.00	---	------
Truck	2	10.00	7	35.00
Replacing sand and cleaning:				
Labor	1	2.00	6	12.00
Filter Sand	¼ yd.	.50	3	6.00
Total Costs		$24.50		$109.00

of three inches from the side retaining walls to the drive strip was maintained for drainage purposes. This slope was reduced to two inches on the remaining beds. A retaining wall was constructed to replace any earth banks to facilitate loading with power equipment. The filter media and drains between the drive strips were left intact to provide drainage for surface water as well as to drain what might accumulate during the sludge drying process.

Tests and Costs

In order to determine the drying nature of this bed it was tested concurrently wtih a sand filter bed. The flow of sludge to the two beds was divided to assure a uniform quality in each bed. The results were then compared as shown in Tables 1 and 2.

Conclusion

It was concluded that with the drying time reduced and a net saving of $84.50 in maintenance costs each time a bed was drawn it would be advantageous to convert the eleven remaining beds. The plant superintendent, Mr. Emil Meyer, was strongly in favor of the change. Plans and specifications were drawn to include cement retaining walls to replace all earth embankments as well as the replacement of the sand with an asphalt surface. The low bid for the conversion was $11,776.00. The work was completed in October of 1957. It might be well to note that if a fine layer of sand is spread on the bed before it is first put into operation it will prevent bonding between the new asphalt and sludge, which could damage the surface of the bed.

South Salt Lake is now experimenting with one converted bed, and it is felt that after sufficient data is obtained, it will affect future designs of sludge beds in Utah.

Pickups from Purdue's "Sanitary Engineering News"

Don E. Bloodgood, Editor

Studies by the U. S. Reclamation Bureau show that covering a reservoir with a thin layer of hexadecanol can save 25 to 30 per cent of the water now evaporating. The chemical spreads automatically on the water's surface.

Tests so far indicate that is nontoxic and the cost is less than 60c an acre of water.

Construction of another $6-million water reservoir either northeast or northwest of Indianapolis is being considered by the Indianapolis Water Company.

In the event of chemical warfare, contamination of water with the nerve gases Sarin and Tabun is possible. Very small quantities of these agents are required to produce toxic symptoms when the water is taken internally.

Twenty privies were treated with dieldrin, ten with DDT and 20 were untreated. The low level of housefly production in the untreated privies and the rapidly increased breeding of the species in the presence of BHC, chlordane, aldrin and dieldrin shows that these chlorinated hydrocarbons insecticides should not be used to treat privies.

The water supply for Dusseldorf is obtained by bank filtration of Rhine River water. Tastes and odors appear in the bank-filtered water.

Gas recirculation in sludge digestion tanks at the Maple Lodge sewage works of the Colne Valley Sewerage Board, England, has been helpful in overcoming scum problems.

Water containing less than 4 ppm of D.O. tends to dissolve iron, especially at points in the distribution system remote from the pumping plant and with low rates of flow.

In 1860, 58% of all American waterworks were privately owned, in 12 of the 16 largest cities they were municipally owned.

Dallas, Texas has been supplying water with 1000 ppm of chlorides to the people of the city. Anyone finding the water unpalatable collects drinking water from taps at certain wells.

A mile of 8-inch cast iron pipe, of the type used for water mains in residential areas, cost $6500 (in 1940) and under normal conditions cost another $4500 to install.

The B.O.D. demand placed on a strawboard sludge deposit may be doubled by any condition which causes disturbance of the deposit.

Time-consuming measurements of lake and stream depths from boat-edge or through holes drilled in the ice has been superseded by use of a sonic depth finder in Michigan Water Resources surveys.

For the United States, in 1956 when statistics were compared with 1955, indicated decreases were reported: Poliomyelitis—48%; Infectious Hepatitis—40%; Brucellosis—10%; Diptheria—21%; Malaria—55%; Meningococcal infections—21%; Tuberculosis—8%; and Pertussis—49%.

The Indiana Stream Pollution Control Board has approved final plans for six sewage treatment and sewer projects having a total estimated cost of $2 million.

An Indianapolis Street Department worker, overcome by gas while working in a sewer, died 47 days later.

Fellow workmen said he was overcome as he tried to climb a ladder to get out of the sewer.

Two other men were also affected by the gas. The men had been removing leaves which had clogged a sewer.

Ordinarily, the minimum pressure in a water distribution system should be not less than 35 to 40 psi.

One of the objectionable effects which can occur from the discharge or waste waters to streams is the excessive growth of filamentous organisms giving rise to the appearance of what has been termed a slime infestation.

A storm of July 12, 1957 (6" in 24 hours) resulted in the highest mosquito activity ever recorded in Cook County, Illinois.

The combined treatment of municipal sewage and tannery wastes on a trickling filter resulted in deposists of lime or calcium on the stones and a lack of biological growth.

In response to many suggestions, *Water & Sewage Works* is pleased to present a collection of . . .

Tributes to the Late Linn H. Enslow

EDITOR'S NOTE: Following the sudden passing of Linn Enslow, early last November, his family and our office received many letters of tribute to him and his service to the field of water supply and sewage disposal. One of our Contributing Editors, Mr. Clarence Keefer of Baltimore, a long time friend of Mr. Enslow's, agreed to collect these letters and organize them for publication. No doubt many other persons would have wished to contribute their comments if they had known of the plan to publish these letters, but this collection represents the thoughts of those more intimate friends who had known Mr. Enslow best over a long period of years. Our own thoughts were summed up in a testimonial published in October, 1956, on the occasion of Linn's 25th anniversary as Editor of *Water & Sewage Works* and in his obituary published in December, 1957.

"I feel honored to contribute to a testimonial to my dear friend Linn Enslow. For more than twenty years Linn has been the 'Big Brother' of the Maine Water Utilities Association, giving freely of his experience and knowledge to those of us who have helped to organize and guide the affairs of that Association.

"Linn's active interest was evidenced by the frequency of his visits to Maine, during which he took active part in the discussions at Association meetings, every remark the result of his wide experience and sound ideas on the subjects he discussed.

"Not the least of Linn's contributions was his hearty endorsement of Maine foods, whether lobsters at Lubec, doughnuts at Portland or a simple 'quickly' salad while the guest of a Maine waterworks superintendent in his home."

Sidney S. Anthony
Supt., Augusta, Me., Water Dist.

"Linn Enslow was an engaging personality and a man who had the instincts and characteristics of a great editor. He loved his field and carried the role of editor with pride and dignity."

W. K. Beard, Jr.
Pres., Assoc. Business Publications

"Linn Enslow was a great man. His name always brought to mind an insatiable desire for information which would advance the processes and procedures in the fields of water, sewage and industrial wastes. He had an inquisitive attitude which compelled him to seek the truth no matter where it led."

A. E. Berry
Gen. Mgr., Ontario
Water Resources Comm.

"Linn H. Enslow was my friend for over thirty years. He was a friend to ALL Water and Sewage Works men, and was known throughout the industry, as he was always seeking new and better ways to improve water and sewage operations.

"Linn gave generously of his time and talent to serve as President of the American Water Works Association, and maintained an active interest in the Federation of Sewage and Industrial Wastes Assns.

"We shall miss him at our Section and Annual Meetings; but we shall remember Linn H. Enslow for his many contributions to the Water and Sewage Industry."

Morrison B. Cunningham
Director of Public Works
Oklahoma City, Okla.

"In the death of Linn H. Enslow, the water supply and sewage fields lost one who had devoted his life to the improvement of all phases of these fields.

"By the written and spoken word, Linn depicted the advancements made in design, construction, operations and maintenance of water and sewage plants and the need of such plants for the protection of health.

"He gave freely of his time to aiding the formation and operation of organizations that were planned to promote useful information to water and sewage groups, at many of the meetings held by such organizations. When attending meetings, he actively took part to develop discussion.

"Linn also strongly advocated developing public interest in the plants and their operation as a basis for securing better plants and well-paid competent personnel."

William W. Brush
Treasurer Emeritus
American Water Works Assn.

"Linn and I were friends of many years standing. There was some twenty years difference in our ages

but long also I sought his counsel on some important decisions which had to be made. From that time on I learned to rely on his judgment and to seek his advice on so many things. He was always friendly, although he might disagree in a passionate way with me and others in arguing a point. So many times he was right. For many years we had a standing luncheon date at the AWWA Convention to discuss matters of mutual interest and in particular, some of the newer developments in the sanitary engineering field. Linn was always anxious to learn of the latest and the best and was keenly interested in reporting these developments to his reading public.

"One of Linn's greatest desires was to raise the standards of the sanitary engineering profession. This included new processes and equipment for the treatment of water, sewage and industrial wastes, and also included analytical methods for more precise and accurate observations of the phenomena which we are trying to control in our processes. One of his last efforts was to take up the cudgel of the Membrane Filter Procedure for the analysis of water. He was eager to read reports of research on the development and application of this procedure and fought valiantly through his own writings and through his seeking of contributors to his magazine to bring this more precise and accurate technique to the attention of the profession.

"One of Linn's editorials in the January 1956 issue of *Water & Sewage Works* carried the headline 'The M. F. Technique Deserves Full Standard Status.' It is ironical that two months after Linn's death the January 1958 issue of the Journal of the American Water Works Assn. carried the banner headline 'Acceptance of Membrane Filter Procedure.' This is just one of the many battles in which Linn engaged in his attempt to uplift the profession through the power of the press and the power of a dynamic individual, so well liked and respected, and so sorely missed!"

Rolf Eliassen
Prof. of San. Engng.
Mass. Inst. Tech.

"In the death of Linn H. Enslow, the water and sewerage works men have lost a real friend. Many of us have been guided by his willingness and knowledge in our every day problems, however small or large they might have been.

"Many an operator was guided by his seemingly unlimited knowledge on construction, maintenance, and management problems. He instilled confidence in the individual, and his fatherly advice was so helpful.

"We, here in New England, looked forward to seeing him at our water works meetings. One of the Associations called him the 'doughnut king.' They always presented him with a box of doughnuts at their annual meeting. He liked them toasted and buttered.

"His untimely death leaves a void that will be hard to fill—as men of his calibre are far and few between. I feel it was a real privilege to have known Linn as a friend and advisor."

Roger Esty
Sales Mgr., Natgun Corp.
Boston

"It was a high privilege and pleasure to have known and worked with Linn Enslow for many years. Our feelings certainly have been duplicated by many throughout the country. Our first awareness of him was as the editor of a noteworthy publication in the field, and soon he appeared at the local water and sewage works association meetings. He seemed well acquainted with the officers and outstanding figures at the meeting, but somehow he found time to mingle with others and to take many pictures of persons and places.

"With the passage of time, our realization of his national stature increased, though he never failed to contact personally the majority of those attending regardless of its location. His provocative comments and questions at meetings often pinpointed the realistic side of a problem so that discussions were kept on a practical and productive basis when he was in attendance. His broad acquaintance with persons and problems in the field was in itself stabilizing because his opinions had the weight of experience and authority.

"Linn Enslow's service to the Federation of Sewage and Industrial Wastes Associations makes a most impressive record. He served as Vice-President for several years prior to the Federation reorganization in 1941. He has always been a member interested in activities and committees of the organization and has made continuous contribution to the Federation's advancement through these efforts. For many years, he was a proponent of the geographical membership directory which has become a regular part of the Federation biennial directory."

Ralph E. Fuhrman
Exec. Secy.
Fed. Sew. & Ind. Waste Assns.

"Linn Enslow's passing brings a sense of personal loss, as it must to many others and I know it does to all who were directly associated with him. Linn always seemed to take a personal interest in our little company and was responsible for getting some of our staff to come with us. The water works profession has lost one of its finest men."

L. E. Harper
Pres., Omega Machine Co.

"It was my good fortune to have known Linn Enslow for well over 30 years. I cherished his friendship; I have a high appreciation of his many contributions toward progress in water and sewage treatment, and his willingness to share with others the vast fund of information which he had accumulated relative to these subjects. It would not be possible to over-evaluate the impact of Linn Enslow toward improved living conditions from the health standpoint. His personal contributions were supplemented by his ability to appraise the work of others and to select and present in readily understandable form the latest progress in water and sewage treatment.

"Linn Enslow will be sorely missed. His contributions toward safe water supplies and improved sanitation are many and important. His presentations through

Water & Sewage Works of carefully selected material were instrumental in raising the standards of practice.

"Linn was a true Virginia gentleman who left an indelible imprint on those who were privileged to know him well. Personally, as well as professionally, Linn's passing is a real loss."

L. R. Howson
Cons. Engr., Chicago

"Linn H. Enslow will go down in history as one of the pathfinders of the water works field. He was gifted with an active and inquiring mind which led him to evaluate intelligently new ideas as they came along and apply those which had merit in his discussions and actions.

"Credit is due him, along with Abel Wolman, for the studies which they made, demonstrating the correlation between the amount of chlorine residual in a treated water and the efficiency of the treatment. Prior to that study, chlorination had been more or less of a hit-and-miss operation. Their work put it on a firm footing. Every person who has benefited by the chlorine treatment of water is indebted to Enslow and Wolman for the studies that they made."

Harry E. Jordan
Secy., Amer. Water Works Asn.

"I first met Linn over thirty years ago when he was associated with the Chlorine Institute. I soon learned that he was greatly interested in research work as it applied to the treatment of sewage. It was not long, therefore, before we were working on problems that dealt with the use of chlorine in sewage treatment.

"Later when he became the Editor of *Water & Sewage Works,* he would stop off in Baltimore on his way to his farm in Virginia, at which time we would discuss projects of mutual interest. Although he was always interested in the theoretical side of any problem, he at the same time did not lose sight of its practical applications. He put his whole heart into any task that he undertook and never spared himself in carrying it through to completion.

"On his many trips to Baltimore I learned that he enjoyed good food, especially if Southern dishes were served. It may have been that the name of the restaurant reminded him of his native state; nevertheless, he always enjoyed having lunch at the Viriginia lunch room. I can still picture him enjoying such dishes as spoon bread, hominy and fried sausage cakes.

"Linn will be greatly missed in the Sanitary Engineering field. He was a man of integrity and honesty, who did not hesitate to express his opinion, regardless of the outcome. He was one, whom the engineering profession can ill afford to lose."

Clarence E. Keefer
Asst. Bur. Engr., Bur. of Sew.
Dept. of Pub. Works, Baltimore

"Linn Enslow's sudden passing will be a great loss to the water and sewage industry, and I am sure a blow to his associates and many, many friends. His friends in our companies join me in expressing our heart-felt sympathy to his family and his associates."

Geo. W. Kelsey
Vice Pres., B-I-F Industries, Inc.

"With the passing of Linn H. Enslow, we who continue, gratefully recognize a heritage which few men bequeath. His activities in so many associations and his unselfish participation by word and pen, evidenced an inquiring spirit, an analytical mind filled with constructive desire. Mr. Enslow's early and continued interest in chlorine practices and research provided the foundations for modern chlorination. By many and varied technical discussions, he shared his knowledge selflessly, thereby inspiring water works men, young and old. Personally, his memory will be revered as a counsellor and friend. His good works remain."

W. R. LaDue
Supt. & Chief Engr.
Bur. Wat. Supply, Akron, O.

"'If thou meetest a man of understanding, let thy footsteps wear a pathway to his door.'

"Many years ago, as a fledgling filter plant superintendent, I met just such a man in Linn Enslow. In my labors and aspirations, he willingly gave me of his time and great talent, even though I must often have seemed dull and ignorant.

"Linn Enslow spoke his truth quietly and clearly, letting the chips fall where they would. My feeling is that our profession was made better by his having passed by this way. And, when that last long night came, I'm sure Linn was able to pull up the covers and say to himself—'I've done my best.'—To which I add, Amen."

R. J. Leveque
Mgr., Sales Services
Omega Machine Co.

"In Memory of a Gentleman—To all of us he was known as Linn. While life was serious, it was always a joy to live it to the fullest. No man could contribute more whether in research, in writing, in speaking or in intimate discussion with friends and strangers.

"For thirty years we have known Linn first in research, later as writer and editor, devoted at all times to the scientific and practical aspects of water supply and waste treatment. No meeting was too small, no distance too long and no effort was too large for him in his devotion to the sanitary engineering profession. He loved a debate on the floor, yet he was gentle unless he found insincerity then he fought for right with superb tenacity. To all of us he has made contributions. We

have gained a treasured memory of a man of great wisdom and spirit. It is fitting he should rest in his beloved hills."

Fred Merryfield
Prof. of San. Engng.
University of Oregon

"Linn Enslow and I were close friends and associated in many Society activities, especially the American Water Works Association, during nearly our entire professional careers. I always admired Linn's penetrating mind and his ingenuity in driving more deeply into every subject which attracted his interest and concentration. He was an indefatigable worker toward the improvement of water supply, sanitation and health. I shall always recall the splendid editorial tribute to his mother, which appeared over his signature in *Water & Sewage Works* at the time of her death. This tribute to his mother was typical of his warmth of friendship and interest in those with whom he was associated, and in the engineering profession."

Samuel B. Morris
Cons. Engr., Los Angeles

"The letter notifying me of Linn Enslow's death was as much of a shock to me as it must have been to all of Linn's friends and business associates. I still find it hard to believe that he is gone and every once in a while think of calling on him for advice. It seems most unfortunate that Linn did not live to see fulfillment of the AWWA plan to institute 'Operation Water Works Management,' for this was a phase of public relations that was dear to his heart."

John H. Murdoch, Jr.
Consultant, Wynnewood, Pa.

"Over thirty years of close association with Linn Enslow in a wide variety of endeavors showed how deeply he was devoted to his wife, his family, the State of Virginia, Black Angus Cattle, and to the Truth. He was incapable of trifling with facts. He refused to speculate about anything where facts were available.

"Having examined the facts he called things as he saw them and if on occasion the facts that he found and the conclusions that he reached were not to one's liking that made no difference, you'd get the facts and Linn Enslow's opinion just as he saw it and nothing could change him.

"Linn Enslow's work with the Virginia State Department of Health, his years of pioneering service to the Chlorine Institute, his leadership as an Editor of the technical press, his work with the American Water Works Association and with the Federation of Sewage & Indutrial Wastes Associations all demonstrated his hunger and thirst for facts.—He was a true engineer."

William J. Orchard
Director, Wallace & Tiernan Co.

"Linn Enslow was a man of notable character, happily married, a good husband, father and grandfather and sincerely devoted to them and his profession. His moral leadership, firm integrity and inspirational dignity with his human understanding and interest in his fellow man and willingness to help them gave him many friends. He was always ready to depart of his knowledge and his many courtesies were sincerely appreciated.

"There will be other Fullers and Enslows, probably doing a better job; but don't let us forget the fellows that hit the trail and gathered the knowledge and know-how and passed it on so that their successors could carry on and do just that thing—a better job.

"In life you harvest what you sow and your crops or dividends are the friends you make."

M. J. Siebert
Neptune Meter Co.
Westmoreland, Va.

"That Linn Enslow was an unusual man was evident to most of us who attended the Virginia Polytechnic Institute with him at the beginning of his career. Even then he had that same friendly manner, the searching, retentive intellect that made him one of the outstanding men in his profession for so many years.

"We who knew him the longest and the best could not help but admire and respect him the most."

Marsden Smith
Chief Water Engr.
Richmond, Va.

"It is almost impossible for me to express to you my feelings for Linn Enslow. His appreciation of Research and Development was much greater than most people realized. With the passing of Mr. Enslow the Water Works and Sewage Treatment field has lost one of its great personalities.

"I personally used to telephone Mr. Enslow long distance for counsel and his opinions certainly were remarkably well founded—I guess from practical experience.

"If there is any way that a medal or a certificate could be awarded to young water works and sewage treatment operators for Research and Development, it should carry the name of the Linn H. Enslow award."

Fred E. Stuart, Jr.
Pres., Stuart Corp.

"I knew Linn Enslow over a period of more than thirty-five years. I knew him as a friend, a fellow member of the same profession, and during recent years as editor. My first acquaintance with him was at the time he was Engineer for the Chlorine Institute. His work in connection with the use of chlorine, particularly in

the treatment of water in the early years, still stands as a definite contribution to the art of water purification.

"During the years that he was editor of *Water & Sewage Works,* he continued to give advice and guidance along all lines of sanitary work.

"He was possessed of a keen sense of humor and was never too involved with his work and with what he was doing to keep him from having a good time with his friends and associates. I know that every person who knew him is missing him greatly. We have lost a friend and the profession has lost a member who contributed much of time and constructive thought to it."

N. T. Veatch
Cons. Engr., Kansas City

"Linn Enslow was one of the most genuine people it has been my privilege to know. He had an intense interest in members of the water and sewage profession and it pleased him to see the results of their work, whether it was a product of their hands or their mind.

"He liked people. Nothing seemed to make him happier than to be with them, and at nearly any gathering his free time was devoted to making new friends and visiting with old ones.

"It was my privilege to know Linn for some years. The first time we met I was attracted by his friendly interest in my work, and it was then that we began a custom of lunching together each time the opportunity presented itself. He was something of a gourmet —at least he enjoyed good food, whether it was an out of the ordinary dish or just a local specialty—and apparently one of the first things he would do after arriving in a city new to him was to find some unusual or special restaurant, then invite a friend or two to share his discovery. Needless to say, these visits over a luncheon table are among the highlights of my recollections of Linn Enslow. The food was important, but secondary to the fellowship that went along with it.

"Who can ever forget Linn at a technical program session? It was reassuring to see him sitting in the front row, taking notes in one of those little notebooks that were his trade-mark. We knew we were going to get something out of the session, if not from the paper being presented, at least from his incisive questions and comments. His would be the first voice to break the deadly silence an unknowledgeable program moderator creates by asking 'Are there any questions from the audience?' If Linn had no questions, his comments often were more informative than the paper presented.

"Linn encouraged amateur writers and authors. For instance, if several program sessions were going on at one time he would commission as many reporters as he needed from among those friends who happened to be handy. Many of these amateurs found that they liked to write as a result of this, and continued on to produce original literary efforts.

"Yes, Linn Enslow meant much to all of us. A friend, advisor, helper. No water or sewage man held too obscure or insignificant a position for him not to find an interest in what they were doing, and it was due to his friendly encouragement that many have grown in stature in the profession.

"We have too few Enslows at best. To lose one is a sad blow, not only to the profession he served but to the friends he leaves behind. How fine a tribute it would be if the pattern of his interest were to be continued through the establishment, in his name, of some sort of an annual award to be given, perhaps on an AWWA or FSIWA section level, for a jury-chosen paper on a water or sewage subject by an AWWA or FSIWA member who had had no previously published work. Perhaps in this way we might carry on at least part of the work so close to his heart."

Henry Wilkens, Jr.
Houston, Tex.

"The loss to the sanitary engineering profession through the untimely death of Linn H. Enslow will be attested by many members of that profession. His contributions to the improvement in our water, sewerage and general physical environment were striking, deeply thoughtful, original and often justifiably unorthodox.

"He combined modesty with a mastery of his subject matter. In him we found a rare combination of a student of chemistry, with a remarkably uncanny practicality in engineering application.

"I like to write of him, however, primarily as a personality. To a large degree, his interest in sanitation stemmed from his early employment in the Maryland State Dept. of Health. There, he in chemistry and I in engineering, spent years together on trains, in automobiles, in office and in laboratory examining the problems of water and sewage treatment. Discussions were pursued day in and day out for years—a custom we renewed each time we met.

"Rarely have I encountered an individual of such acuity of perception on field inspection, and of such rapidity of discerning key causes and of such capacity for developing simple and definitive aids for treatment performance.

"With all of his seriousness of approach to the problems in his chosen field, he rarely lost the twinkle in his eye nor the discernment of the phony or meretricious in technical discussion.

"It is difficult, after some 40 years of almost continuous work with Linn Enslow, to speak of him in the past tense. Actually, he will live on for many decades to come.

"It is only fitting that I should record at least some of his extra-ordinary and cherished characteristics."

Abel Wolman
Cons. Engr., Baltimore

The Editor's Comments

Tributes to a Former Editor

Beginning on page 349 of this issue, there are a number of letters of tribute to the late Linn H. Enslow, who edited this magazine for 26 years. How these letters came to be collected is explained in the Editor's Note on that page; the letters themselves speak for the thoughts of a number of Linn's more intimate friends. Undoubtedly, too, these letters express the feelings of many persons who knew Linn only professionally through this magazine and through his active work in the American Water Works Assn.

As one reads these letters, there seem to be two threads of thought that weave in and out of the collection. The first was the general recognition of Linn Enslow's sincere devotion to the ascertaining of facts in any situation coupled with a devotion to the truth. The second was his steadfast defense of his opinions if he felt they were based on fact. Both of these qualities stemmed from his interest in research.

Another comment that appears frequently in these letters is the observation that Linn was fond of good food, and more particularly of unusual foods. It is true that he was a gourmet in the true sense of the word and he not only enjoyed good food but the fellowship of sharing it with his friends.

Two of the letters in the collection make the suggestion that Linn Enslow's name and memory should be perpetuated by some sort of memorial or honor bestowed on future workers in the field of water and sewage treatment. One suggests an award in his name for research; the other suggests an award for writing, particularly to neophyte authors.

Both suggestions are interesting and thought provoking. I know I speak for the publisher of this magazine, when I say that if any persons or organizations are interested in acting further on these suggestions, WATER & SEWAGE WORKS would like to participate in any way feasible.

Industrial Waste Treatment

A number of readers have asked: "What is the interest of WATER & SEWAGE WORKS in industrial wastes since it has a sister publication devoted exclusively to that subject?" This is a fair question.

From the standpoint of editorial coverage, WATER & SEWAGE WORKS devotes no space to articles which deal with industrial waste problems or their solution within an industrial plant. On the other hand, however, this magazine is interested in publishing articles dealing with the effects of industrial waste on municipal sewers, sewage treatment facilities and processes.

This magazine is also interested in the effects of industrial wastes on the pollution of streams and lakes, particularly if those streams also receive the discharge of effluents from municipal sewage treatment works, and especially if those streams are utilized as sources of municipal water supply. By the same token, this magazine is interested in the discharge of industrial wastes, treated or untreated, into ground water aquifers, especially if those aquifers are used for water supply.

Thus, there is an area of the industrial waste problem that is of interest to this magazine and its readers.

Now, to make the answer to the question complete, the interests and field of coverage of *Industrial Wastes* should be explained. First, *Industrial Wastes* covers the entire field of wastes from manufacturing processes and operations; this means liquid wastes, gaseous wastes and solid wastes from industry—in short, the abatement of stream pollution, air pollution and land contamination.

In the coverage of these several phases of industrial problems, the magazine, *Industrial Wastes,* publishes material on in-plant processes and revisions thereof, as well as the more familiar external treatment processes, particularly with respect to liquid wastes. Naturally, *Industrial Wastes* magazine is also interested in industrial water supply and in the disposal of liquid wastes to municipal sewage treatment plants and the effects of liquid industrial wastes on streams. In this respect, these two magazines have an overlapping interest but otherfise there is a distinct line of demarcation.

This is the answer to: "What interest does WATER & SEWAGE WORKS have in the industrial waste field?"

Industrial Waste Treatment Gains

Having delineated the interest of this magazine in industrial waste treatment, it seems pertinent to comment briefly on some recent forward steps in the treatment of liquid industrial waste.

Within recent months, reports in the technical press have noted several advancements in industrial waste treatment: The Ohio River Valley Sanitation Commission is on its way toward the solution of the problem of salt pollution of the Ohio River. The Chemstrand Corp., at Pensacola, Fla., described at the Purdue Industrial Waste Conference how an "untreatable" nylon waste was treated. The steel industry has indicated that the Ruthner process for recovery of pickle liquor appears to be economically feasible. The American Cyanamid Co. has dedicated a new plant using an adaptation of the activated sludge process for treating its wastes at Bound Brook, N. J.

All of these accomplishments are signs of present and future abatement of stream pollution by industry. In addition, the American Cyanamid Co. plant plans to treat municipal wastes from nearby communities; this is a switch on industry-municipal relationships.

These advancements certainly fall into the area of interest to both *Industrial Wastes* and WATER & SEWAGE WORKS.

George E. Symons.

"from Chicago"

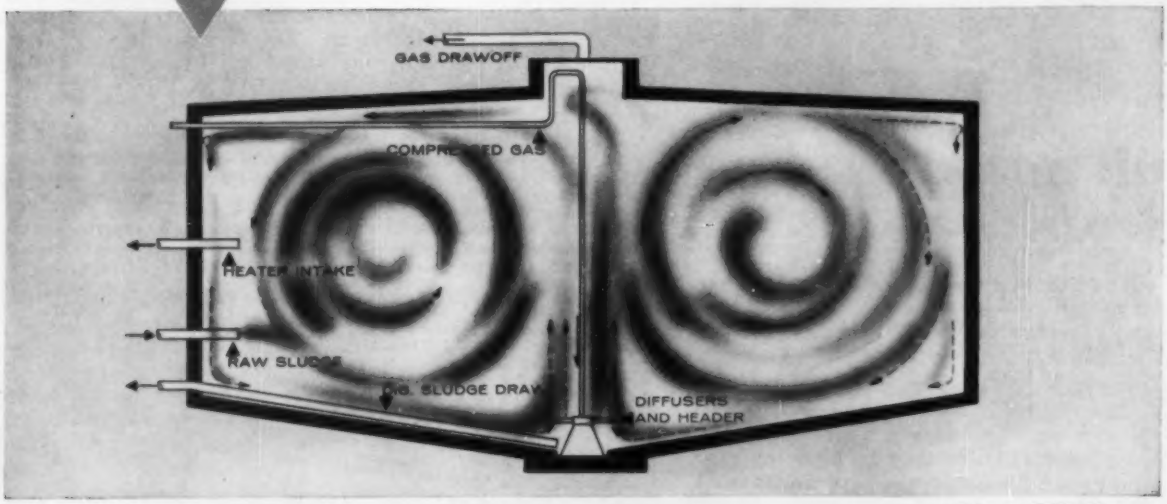
Accelerated
CRP*
Sludge Digestion System

*Catalytic Reduction Process . . a trademark of Chicago Pump Company

the Accelerated Sludge Digestion System... for Unparalleled Savings

Only CRP* Has Achieved These Results

- **A 3 to 7 times greater solids loading for existing tanks**
- **A ⅓ reduction in the size of new tanks**
- **Greatly reduced operating problems due to digester homogeneity**
- **Sludge digestion without scum**



Primary CRP* Digester

THIS IS THE CRP* PROCESS

Patent Nos. 2,777,815 and 2,786,025 . . . others pending

The CRP* Gas Treating System provides . . .

- ***correct biological environment for accelerated digestion***
- ***continuous, complete homogeneity of digesting solids***
- ***transfer of digested sludge in a homogeneous state maintained by continuous gas diffusion in the primary tank***

CRP* was tested and proven scientifically for seven (7) years prior to introduction to the field. The completely successful operation in 18 Municipal Plants since 1953, has verified this system.

Consulting Engineers may obtain specific data from Chicago Pump Company or Distributors located in most principal cities . . . concerning the application of CRP* to plants under design or plants requiring expansion.

there are 21 CRP* systems in successful operation . . . 10 more on order.

fmc
FOOD MACHINERY AND CHEMICAL CORPORATION

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

Chicago Pump Company

622 DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

Copyright 1958—Chicago Pump Company

TWO WEINMAN TYPE U-VM PUMPS INSTALLED . . .

Two 6" Weinman Type U-VM pumps operating at Circleville No. 1 station water and sewage works, Circleville, Ohio.

all non-clog pumping worries over!

Your non-clog pumping requirements can be solved quickly, efficiently and permanently, with economical WEINMAN Close Coupled, Vertical, Type U-VM, Non-Clog Unipumps.

Designed for limited space applications, these pumps are widely used to effectively handle liquids carrying large solids, stringy or fibrous trash and material suspended in sludge form.

Specially designed cast iron, two-vaned, enclosed-type impellers produce a steep head capacity curve to help prevent clogging in the discharge line. Thousands are already in use in municipal and industrial sewage treatment plants . . . industrial and processing operations . . . and for handling semi-solids, wastes, heavy viscosity fluids and liquids containing solids.

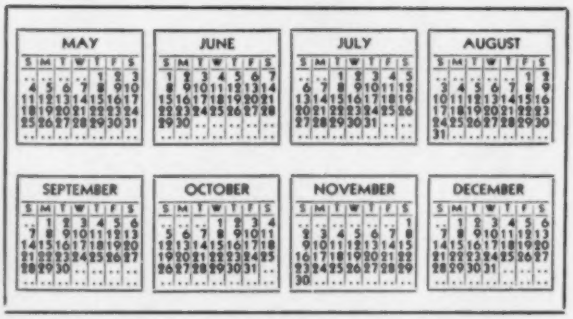
It will pay you to investigate the full range of WEINMAN *Vertical Type U-VM Non-Clog Unipumps! Send for free illustrated Bulletin 1410, showing specifications, dimensions and construction features of* WEINMAN *Close Coupled, Vertical, Type U-VM Non-Clog Unipumps.*

THE WEINMAN PUMP MFG CO
290 SPRUCE ST. COLUMBUS 8, OHIO

CENTRIFUGAL SPECIALISTS

Meetings

1958



Aug. 11-13—University Park *(Pa. University)*
PENNSYLVANIA WATER WORKS OPERATORS' ASSN., Secy., Harry A. DeWire, 29 Chestnut St., Lewistown, Pa.

Aug. 13-15—University Park, Pa. *(Pa. University)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., J. R. Harvey, 916 Diamond, Meadville, Pa.

Aug. 14—Millinocket, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Aug. 27—Chicago, Ill. *(Sherman Hotel)*
WATER SUPPLY CONFERENCE ON WATER POLLUTION ABATEMENT, Illinois State Chamber of Commerce, Secy., J. G. Ronchetto, Water Resources Committee, Illinois State Chamber of Commerce, 20 North Wacker Drive, Chicago 6, Ill.

Sept. 7-12—Chicago, Ill.
AMERICAN CHEMICAL SOCIETY, 134th National Meeting, Water, Sewage & Sanitation, Secy., H. B. Gustafson, P. O. Box 5033, Tucson, Ariz.

Sept. 8-10—Grand Rapids, Mich. *(Pantlind Hotel)*
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Valde, Chief, Michigan Dept. of Health, DeWitt Rd., Lansing 4, Mich.

Sept. 8-12—Raleigh, N. C. *(N. C. State College)*
SEWAGE & INDUSTRIAL WASTES OPERATORS SCHOOL, College Extension Div., N. C. State College, Box 5125, Raleigh, N. C.

Sept. 10-12—Lake Placid, N. Y. *(Lake Placid Club)*
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 19 West 50th St., New York 20, N. Y.

Sept. 10-12—Atlanta, Ga. *(Georgia Tech)*
GEORGIA WATER & SEWAGE ASSN., Secy., A. T. Storey, Atlanta Water Works, 1210 Hemphill Ave. N.W., Atlanta 13, Ga.

Sept. 14-17—Poland Springs, Maine *(Poland Springs House)*
NEW ENGLAND WATER WORKS ASSOCIATION, Secy., Joseph C. Knox, N.E.W.W.A., 73 Tremont St., Boston 8, Mass.

Sept. 15-17—Denver, Colo. *(Cosmopolitan Hotel)*
ROCKY MOUNTAIN SECTION, A.W.W.A., Secy., V. A. Vaseen, Ripple & Howe, 426 Cooper Bldg., Denver 2, Colo.

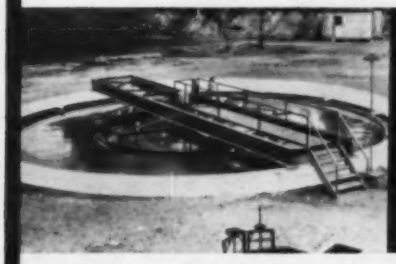
(Jointly With)

ROCKY MOUNTAIN SEWAGE WORKS ASSN., Secy., Verne E. Plath, P. O. Box 149, Englewood, Colo.

CONTINUED ON PAGE 94A

YEOMANS MANUFACTURES THE MOST COMPLETE LINE OF APPLICATION-DESIGNED SEWAGE TREATMENT EQUIPMENT

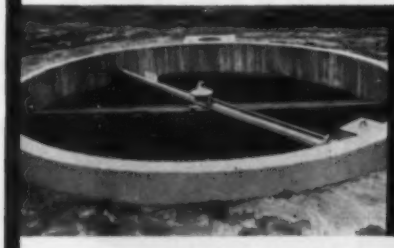
which includes..



. . SPIRAFLO CLARIFIER for both primary and final clarification of domestic and process wastes. A clarifier of radically different design, the Spiraflo offers complete settleable solids removal; greater removal of finely divided particles; positive grease, scum oil removal; uniform velocity throughout tank; and straight wall design which reduces construction costs.

. . the HI-CONE, the most important development in the surface aeration process of activated sludge treatment in the last 30 years. The Hi-Cone offers much greater circulation, and can handle substantially more sewage with no increase in power consumption per MG treated. Maintenance costs are minimized because nothing can clog.

. . the CAVITATOR, a newly developed Yeomans unit for low cost treatment of both domestic sewage and industrial wastes. Perfectly suited for small communities, subdivisions, motels, resorts, schools and industrial plants, the Cavitator has excellent purification efficiency, extremely high oxygen transfer efficiency, and extremely low air requirements per pound of B.O.D. removed.



. . the WATER-WHEEL, a rotary distributor used with trickling filter systems in the secondary treatment of sewage. An exceptionally rugged, yet simple piece of equipment, the Water-wheel provides uniform distribution over the entire filter bed at all flow rates . . even the lowest. Costly accessories, such as underground feed pipe, dosing chamber with siphon, center support, and mercury seal, are not required.

. . YEOMANS ROTARY DISTRIBUTORS (both standard rate and high capacity). Standard rate units distribute evenly across the entire filter bed . . adjustable nozzles produce fine, well-aerated spray which carries down high volumes of oxygen. For high capacity filters, both the Yeomans high capacity type distributor and the Aero-Filter system are available.

YEOMANS

1999-9 N. RUBY STREET
MELROSE PARK, ILL.

manufacturers of:

distributors • clarifiers

mechanical aerators

pneumatic sewage ejectors

digesters • centrifugal pumps

Use this coupon to request literature on Yeomans products—please specify

Literature Desired:

_____

_____

_____

name _____

company _____

street _____

city _____ *zone* _____ *state* _____

Mail to: YEOMANS, 1999-9 N. Ruby Street, Melrose Park, Illinois

Sept. 17-19—Cleveland, Ohio *(Statler Hotel)*
OHIO SECTION, A.W.W.A., Secy., J. H. Bass, Robert F. McGivern & Assoc., 1771 West Fifth Ave., Columbus 12, Ohio

Sept. 17-19—Wausau, Wis. *(Hotel Wausau)*
WISCONSIN SECTION, A.W.W.A., Secy., Harry Breimeister, City Engineers Office, City Hall, Milwaukee 2.

Sept. 17-19—Deadwood, S. D. *(Franklin Hotel)*
SOUTH DAKOTA WATER & SEWAGE WORKS CONF., Secy., Don C. Kalda, Pierre, S. D.

Sept. 22-24—Memphis, Tenn. *(Peabody Hotel)*
KENTUCKY-TENNESSEE SECTION, A.W.W.A., Secy., J. Wiley Finney, Jr., Howard K. Bell, Cons. Engrs., 553 So. Limestone St., Lexington, Ky.
(Jointly With)
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSN., Secy., S. Leary Jones, Cordell Hull Bldg., Nashville, Tenn.

Sept. 24-25—Stillwater, Okla. *(A & M College)*
OKLAHOMA INDUSTRIAL WASTES CONF., Secy., H. M. Crane, 3400 Northeastern, Oklahoma City 5, Okla.

Sept. 24-26—Dickinson, N. D. *(Ray Hotel)*
NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Secy., W. Van Heuvelen, Bismarck, N. D.

Sept. 24-26—Duluth, Minn. *(Hotel Duluth)*
NORTH CENTRAL SECTION, A.W.W.A., Secy., L. N. Thompson, Gen. Mgr., Water Dept., St. Paul 2, Minn.

Sept. 25-27—Spokane, Wash. *(Davenport Hotel)*
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSN., Secy., G. H. Dunstan, Box 176, Pullman, Wash.

Sept. 28-30—Jefferson City, Mo. *(Hotel Governor)*
MISSOURI SECTION, A.W.W.A. AND MISSOURI WATER & SEWERAGE-CONFERENCE, Joint Meeting, Secy., Warren A. Kramer, State Office Bldg., 6th Floor, Jefferson City, Mo.

Sept. 28-Oct. 1—Biloxi, Miss. *(Buena Vista Hotel)*
ALABAMA-MISSISSIPPI SECTION, A.W.W.A., Secy., C. M. Mathews, Gen. Mgr., Greenwood Utility, Greenwood, Miss.

Oct. 1-3—Dickinson, N. D. *(Ray Hotel)*
NORTH DAKOTA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Jerome H. Svore, c/o State Dept. of Health, Bismarck, N. D.

Oct. 1-3—Fredericton, New Brunswick *(Lord Beaverbrook Hotel)*
CANADIAN SECTION, Maritime Branch, Secy., J. D. Kline, Asst. Mgr. & Ch. Engr., 162 Lady Hammond Rd., Halifax, N. S.

Oct. 5-9—Detroit, Mich. *(Sheraton-Cadillac Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSN., Ralph E. Fuhrmann, Exec. Secy., 4435 Wisconsin Ave., N.W., Washington 16, D. C.

Oct. 9—Bingham, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Oct. 13-17—New York, N. Y. *(Hotel Statler)*
AMERICAN SOCIETY OF CIVIL ENGINEERS, W. H. Wisely, Exec. Secy., 33 W. 39th St., New York 18, N. Y.

Oct. 14-17—Atlantic City, N. J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSN., Secy., David Dunlap, 2609 N. Second Street, Harrisburg, Pa.

Oct. 15-17—Des Moines, Ia. *(Hotel Fort Des Moines)*
IOWA SECTION, A.W.W.A., Secy., J. J. Hail, Supt., Water Dept., City Hall, Dubuque, Ia.

The Heart of fine WATER PURIFICATION

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

SYSTEMS

Roberts Mechanical Equipment

ROBERTS FILTER Mfg. Co.
607 COLUMBIA AVE.
DARBY, PA.

switch to
Anthrafilt
Trade Mark Reg. U.S. Pat. off.

THE MODERN ALL-PURPOSE FILTERING MEDIUM

Best for All Types of Filters

ANTHRAFILT
offers important advantages over sand and quartz

DOUBLES length of filter runs.
REQUIRES only half as much wash water.
KEEPS filters in service over longer periods.
INCREASES filter output with better quality effluent.
GIVES better support to synthetic resins.
PROVIDES better removal of fibrous materials, bacteria, micro-organic matter, taste, order, etc.
IDEAL for industrial acid and alkaline solutions.
EFFECTIVE filtration from entire bed.
LESS coating, caking or balling with mud, lime, iron or manganese.

Write for further information, test samples and quotations to:

PALMER FILTER EQUIPMENT CO.
P. O. Box 1696—822 E. 8th St., Erie, Pa.

Representing
ANTHRACITE EQUIPMENT CORP.
Anthracite Institute Bldg.,
Wilkes-Barre, Pa.

ROTO-TROL

RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data
WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
783 Hampden Ave., St. Paul 4, Minn.

standardize on

MUELLER®

the complete line of water service equipment...

Mueller offers the complete line of water service equipment—a line backed by a century of manufacturing experience and technical "know-how". Specify Mueller, and you insure longer, more dependable service and reduced maintenance costs. One source of supply can reduce your costs and insure a system of components matched in quality and performance.

SPECIFY MUELLER

MUELLER CO. Since 1857 SERVING the Water and Gas Industries QUALITY

MUELLER CO.
DECATUR, ILL.

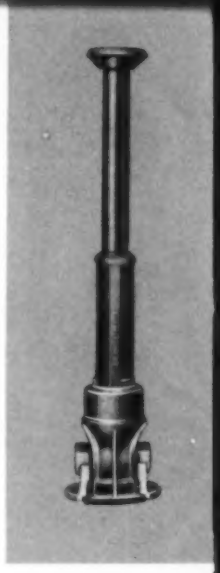
Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

rinted in U.S.A.

Form No. W-8880

ENGINEERED...

water service products

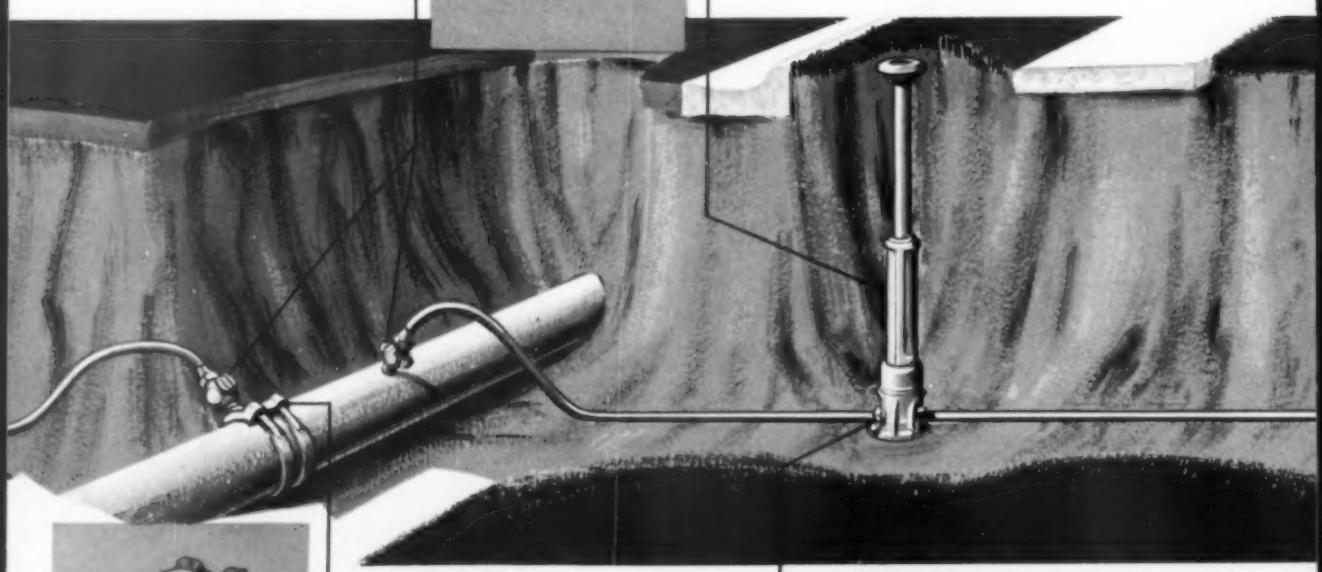


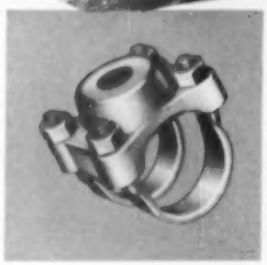
CURB BOXES

Telescopic type—prevents damage to stop or service piping . . . upper section slides in lower section . . . strong phosphor-bronze spring holds upper section in desired position . . . iron to bronze threads assure easy plug or lid removal . . . coated inside and out with tar base enamel to increase resistance to corrosion . . . with or without stationary rod.

CORPORATION STOPS

Quality ground-key construction . . . precision fitted and lapped . . . assures water-tight closure and ease of operation at all times . . . practically any end connection combination to meet every application.



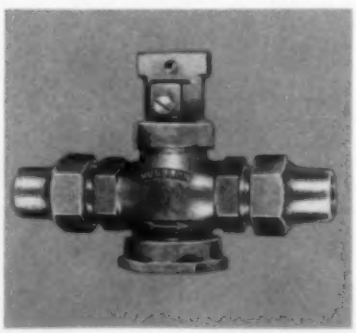


SERVICE CLAMPS

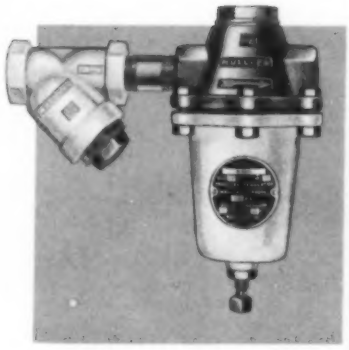
For quick, safe connections to any type main under pressure . . . heavily galvanized malleable iron bodies . . . flattened forged steel straps, cadmium plated, give maximum strength and rigidity for long life . . . single or double strap type for 1" to 12" diameter mains . . . full range of tap sizes.

CURB STOPS

Cast and machined from finest water works bronze . . . inverted key individually ground and lapped, seats with the pressure, assuring water tight closure . . . seating force increases with increase in water pressure . . . various combinations of inlets and outlets for any type of service pipe . . . sizes ½" through 2".



MUELLER CO.
DECATUR, ILL.



REGULATORS

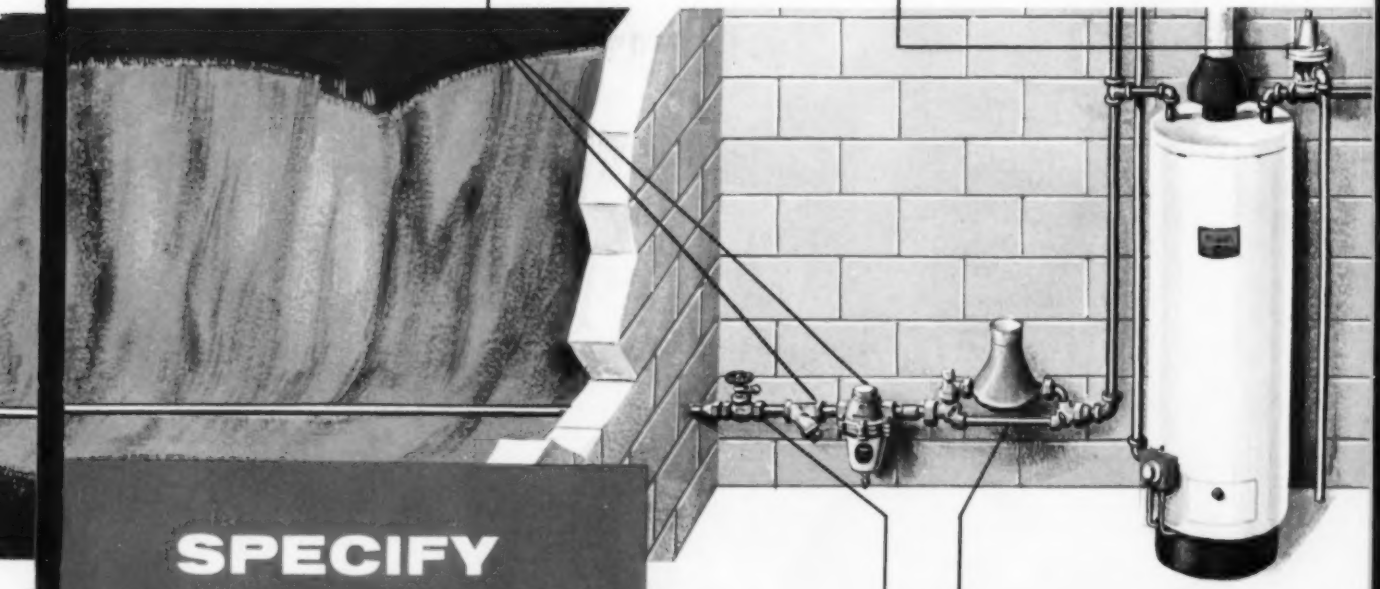
Give pipe capacity flow with "minimum fall-off" of reduced pressure . . . accurately proportioned seat, diaphragm, and spring regulate flow without chattering or flow pulsation . . . outlet pressure adjustment from 5 p.s.i. to 125 p.s.i. . . . for water service.

STRAINERS

For water service . . . galvanized iron or bronze sediment bowl type with clean-out plug gives long life . . . Y-type strainer with monel screen and clean-out plug—screen area four times pipe area . . . I.P. pipe connections . . . wide range of sizes.

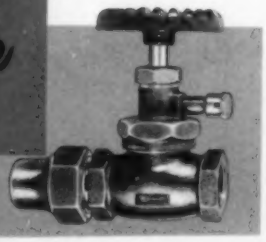
RELIEF VALVES

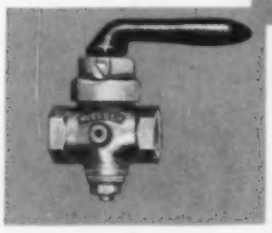
Monel or phosphor-bronze diaphragms and stainless steel seats assure positive operation at all times . . . fusible plugs for thermal relief . . . combined pressure and thermal relief models available . . . pressure relief to 160 p.s.i. . . . thermal relief to 212° F.



SPECIFY MUELLER

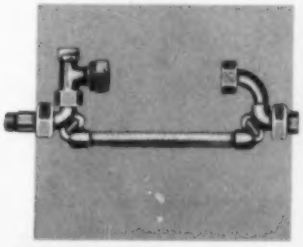
...all along the line





ROUGH PLUMBING

Deluxe quality ground key or compression stops with or without drains . . . Mueller red brass construction . . . popular lawn and sediment faucets with standard hose threads and handwheels . . . bronze gate valves . . . sizes and connections to meet every residential and industrial application.



METER SETTING EQUIPMENT

Mueller engineered meter yokes provide tailor-made installations . . . reduce installation time and protect meters from piping stresses . . . copper yokes and relocaters with or without stops . . . iron meter yokes . . . angle or lock-wing meter stops, ground key construction . . . meter couplings and meter box covers to complete the installation.

other

MUELLER®

service products

SOLID TEE HEAD CURB STOPS

Solid Tee Head curb stops feature a one-piece key and tee. The combined key and tee provide a much stronger unit. The key and body, cast from waterworks bronze, are precision machined and lapped to assure pressure tightness. The regular or Minneapolis patterns are available in sizes ½" to 2" with or without checks and drains.

GOOSENECKS

Three types of connections are available—wiped joint, lead flange, and solder joint. The wiped joint and lead flange goosenecks are available with 2 to 8 branch connections. Corporation stops can be furnished with each gooseneck. Extra Strong or Double Extra Strong lead pipe is used exclusively.

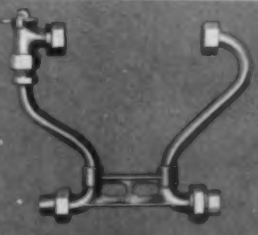
SERVICE FITTINGS

Mueller Co. manufactures a complete array of service fittings. Elbows, tees, corporation stop couplings, branch connections, unions, lead flange fittings and solder nipples and plugs form a complete selection. Sizes are available for every application.

COMPRESSION STOPS

High quality red brass construction. Wheel handles and optional drains make them quite popular for use as meter stops and customer cut-offs just inside the house. Iron or copper pipe connections, sizes ⅜" to 1".

For additional information and service, consult your Mueller Representative or write direct.



COPPER METER YOKES

Especially designed to overcome piping stresses and prevent subsequent damage to the meter. Flexible copper yokes give faster, easier installations even when the service pipe is out of line. Copper yokes are available with or without angle meter stops for ⅝", ⅝"x ¾", ¾" and 1" meters.

MUELLER CO. Since 1857 SERVING the Water and Gas Industries QUALITY

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

You can depend upon Omega for the most complete line of SODA ASH FEEDERS. Omega is backed by a wealth of practical experience and equipment knowledge to help you to select the right feeder for your requirements. In addition, Omega will supply auxiliary equipment and instrumentation: totalizers, master control panels, remote controls, proportional pacing systems, alarms, batch counters, and other related units.

Send for Bulletins you want . . . see table at right. **Omega Machine Co., 350 Harris Ave., Providence 1, R. I.**

	CLASS OF FEEDER	ACCURACY	RANGES		BULLETIN NUMBER
			MIN.	MAX.	
GRAVIMETRIC (WEIGHING) DRY FEEDERS Required for Precision Automation and Instrumentation	MODEL 30-1 LOSS-IN-WEIGHT	± ½ of 1% by weight	½ to 50 lbs./hr.	7.5 to 750 lbs./hr.	30-H12A
	MODEL 50-B BELT	± 1% by weight	2 to 200 lbs./hr.	25 to 2,500 lbs./hr.	35-G5A
	MODEL 37-20 BELT	± 1% by weight	6 to 600 lbs./hr.	100 to 10,000 lbs./hr.	35-H62
VOLUMETRIC DRY FEEDERS For Limited Automation But No Instrumentation	MODEL 50A DISC	± 1% by volume 3% by weight	.25 to 5 lbs./hr.	2 to 40 lbs./hr.	50-K57A
	MODEL 20 UNIVERSAL	± 1% by volume 5% by weight	.5 to 20 lbs./hr.	5 to 200 lbs./hr.	20-P2
	MODEL 45 ROTOLOCK	± 1% by volume 5% by weight	1.5 to 150 lbs./hr.	50 to 5,000 lbs./hr.	45-H8
VOLUMETRIC SOLUTION OR SLURRY FEEDER	MODEL 65 ROTODIP	± 1% by volume	5 to 200 gal./hr.	18 to 1,800 gal./hr.	65-H12B

OMEGA MACHINE CO.
DIVISION OF
B-I-F INDUSTRIES
METERS
FEEDERS
CONTROLS

HEAVY-DUTY
ELLIS PIPE CUTTER
FOR CUTTING LARGE SIZE PIPE

Drop-Forged Frame and Links

Long-Lasting Cutter Wheels

Makes a Hit With Water Works Men

Cuts Pipe in or Out of Ditch

TWO SIZES

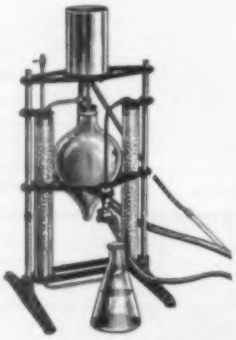
No. 01 for 4" to 8" Pipe
No. 1 for 4" to 12" Pipe

Write for Circular and Price List No. 40WS

ELLIS & FORD MFG. CO.
FERNDALE 20, MICH.

ENSLOW

STABILITY INDICATOR



For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

WRITE:

Phipps & Bird, Inc.
P. O. Box 2V Richmond 5, Va.

News of Suppliers

Jeffrey Assigns Seven To Field Offices

The Jeffrey Mfg. Co., Columbus, Ohio, has announced the assignment of seven graduates of the company's Sales Training Program to District Offices. Completing the two years intensive study at Columbus, all the men have assumed their new duties.

The assignments are: Roy Adams to Birmingham, Ala.; Melvin Ledger to Buffalo, N. Y.; Alex Steele to Bluefield, W. Va.; Al Pingpank to Columbus, Ohio; John Sherrell to Houston, Texas; William Taylor to Milwaukee, Wis.; and Keith Beachler to the San Francisco, Calif.; office.

W-K-M Promotes Butler

W-K-M, division of ACF Industries, Inc., Houston, Texas, has announced that Robert D. Butler has been appointed to the position of Assistant to Sales Manager-Plug Valves.

Mr. Butler joined the company in 1953 as Sales Representative-Plug Valves in the Southeastern part of the United States. He will be located in Houston in new assignment reporting to W. A. Gormley, Sales Manager-Plug Valves.

Meader and Brex Jr., Promoted by B-I-F

B-I-F Industries, Inc., Providence, R. I., has announced the promotion of Davol H. Meader and Charles J. Brex, Jr. Mr. Meader, who has been Advertising Manager since 1955, becomes Administrative Assistant to Vice President G. W. Kelsey. Mr. Brex, who succeeds Mr. Meader as Advertising Manager, joined the company earlier this year as Assistant Advertising Manager.

Mr. Meader graduated from Brown University, and served as Personnel Manager with the Providence Washington Insurance Co. before joining B-I-F Industries in 1951 as Assistant Export Sales Manager for the Proportioneers, Inc., division.

Mr. Brex attended Johns Hopkins and graduated from Columbia in 1946, after service as a first lieutenant in the Army during World War II. He was formerly with Fuller & Smith & Ross, Inc., Assistant Company Promotion for the McGraw-Hill Publishing Company, and Promotion Manager for American Metal Market.

Ray Golly Joins Smith & Loveless

Smith & Loveless, Inc., Lenexa, Kansas has announced that M. R. "Ray" Golly has joined the company

as Chief Sanitary Engineer. Mr. Golly was formerly with the Sewage Section of the Illinois State Department of Public Health and Greeley and Hansen, Consulting Engineers.

FLOmatcher solves variable-flow sewage pumping problems

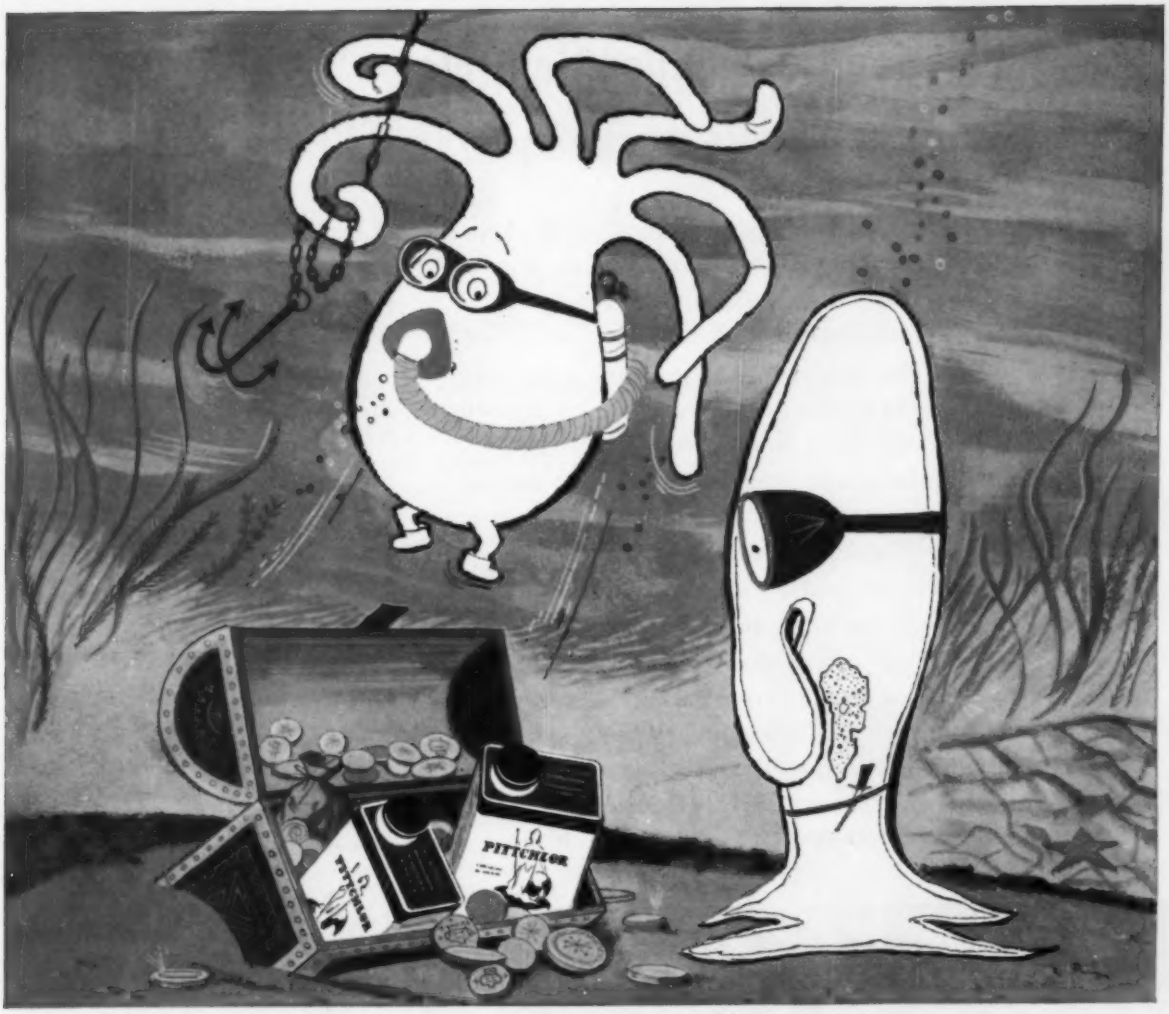
IF you must solve the problem of moving sewage or waste uphill or over difficult terrain...

GET the facts about the FLOmatcher system of variable flow sewage pumping control...

WHICH gives your pumps gravity stability of flow, without steps or surges, thus decreasing maintenance and costs, and giving you higher output from smaller pumping systems.

FLOmatcher
a product of
GENERAL SERVICES CO.
CORVALLIS, OREGON

GET THE FULL STORY . . . CONTACT
GEORGE M. OSGOOD CO.
NATL. SALES REP P O BOX 361 PORTLAND, OREGON • CA 2-1953



Don't touch it, Orgie . . .
if we open those PITTCHLOR® cans we're goners!

Might just as well have Captain Kidd himself guarding that treasure chest. Those cans of Columbia-Southern Pittchlor® and Pittabs® will keep you boys from spending even one barnacle-encrusted doubloon.

Columbia-Southern's high test calcium hypochlorites answer virtually every problem presented by chlorine-susceptible bacteria and algae. Granular form Pittchlor provides the *quick* release of 70% minimum available chlorine sometimes needed. Tablet form Pittabs release the same content over *prolonged* periods for continuous chlorination.

Both forms give you sure and economical protection, and can be used either mechanically or manually without delay or fuss. Why not contact your nearest Columbia-Southern distributor today?

The Columbia-Southern Chemical Corporation, One Gateway Center, Pittsburgh 22, Pennsylvania. Offices in principal cities. In Canada: Standard Chemical Limited.

PITTABS—Packaged in resealable cans, 7½ lb. (6 per case) and 3 lb. (5 per carton). Also in 100 lb. drums.

PITTCHLOR—Packaged in resealable cans, 5 lb. (9 per case) and 2½ lb. (6 per carton). Also in 100 lb. drums.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

A Subsidiary of Pittsburgh Plate Glass Company

Compact Design...Simplified Controls

YOURS WITH THE BUCKEYE 407!

Streamlined and compact, the GarWood-Buckeye 407 digs low-cost ditch where you want it... the way you want it. Simplified controls assure top performance every time.

With the 407, simple lever shifting provides speeds that are easy to find and use. Independent lever steering is exceptionally easy, positive and reliable. Push-button control lets you shift conveyor *electrically* while you continue digging and remain in the operator's seat. Live, hydraulic boom control makes it easy to hold desired grade at top digging speeds.

Learn more about the world's *largest selling* ladder-type ditcher. Your Buckeye dealer demonstrates the 407 and other wheel and ladder-type models in this advanced line. Call him today or write to: Customer Service Dept., Gar Wood Industries, Inc., Wayne, Michigan.

Gar Wood Excavators | Gar Wood—St. Paul Hoists and Bodies | Gar Wood Winches

GarWood INDUSTRIES, INC.

Findlay, Ohio • Wayne, Michigan

News of Suppliers

CONTINUED FROM PAGE 100A

Clay Pipe Institute Appoints Chase Manager-Secretary

The Clay Pipe Institute, Los Angeles, Calif., has announced the appointment of David G. Chase as Manager-Secretary of the Institute. Mr. Chase, a graduate of Michigan College of Mining and Technology in Civil Engineering, comes to the Institute with vast experience in the sanitary engineering, construction and materials fields.

A veteran of World War II and Korea, Mr. Chase is a member of The Southern California Chapter of A. S. C. E.

J-M Opens Continuous, Automatic Transite Pipe Plant in Texas

Johns-Manville, New York, N. Y., has announced the opening of the new Transite Pipe plant at Denison, Tex. The new plant introduces the first continuous, automatic manufacture of asbestos-cement pipe in the United States.

This almost completely automatic factory, controlled by electronic devices, is an innovation in the American asbestos-cement pipe industry comparable to the first continuous strip steel mill or the first continuous process for extrusion of metal pipe, according to company engineers.

Johns-Manville engineers and production specialists believe this new method of production in the United States will make possible a superior type of Transite asbestos-cement pipe and enable the company to increase unit production by at least 30 percent over production attained by previous methods.

The continuous process machine, designed by Johns-Manville engineers along the lines of the Mazza type, was built by the M. L. Bayard Company of Philadelphia to the design and specifications of Johns-Manville.

Now Available – Crane A.W.W.A. Valves with "Ring-Tite"* and "Fluid-Tite"** Ends

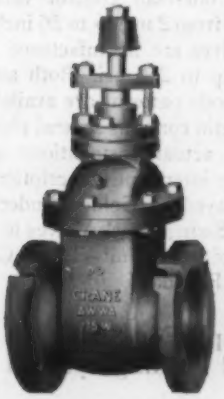
Two new Crane A.W.W.A. valves for use with asbestos-cement pipe —"Ring-Tite" and "Fluid-Tite"—are available in 3, 4, 6, 8, 10 and 12-inch sizes. These valves—added to Crane hub, flanged and mechanical joint end patterns—enable you to specify Crane quality for most A.W.W.A. valve installations.

More Advantages in Crane Quality

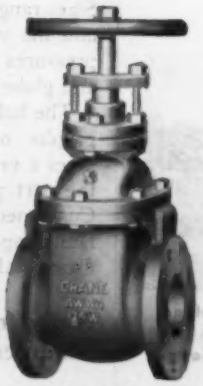
You can put Crane A.W.W.A. valves into service with no question of operating dependability when needed. They're engineered to give long-term trouble-free, maintenance-free service. Here are some of their advantages:

1. **Simple, 4-piece disc assembly and guide rib design—can't jam or become disengaged in service.**
2. **Trunnion-mounted rotating discs move freely . . . prevent wear on disc and seat.**
3. **Positive wedging action seats discs tightly**
4. **Non-binding ball-type gland and gland flange**
5. **Meet A.W.W.A. standard specifications**
6. **All patterns available either bronze-trimmed or with all-bronze internal parts with "Ni-Vee"‡ bronze stems**
7. **Choice of two types of stuffing boxes—with "O" ring seals or conventional packing**

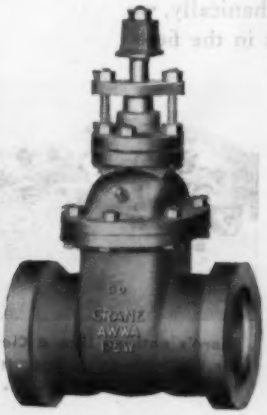
For complete details, ask your Crane Representative for information, or write to the address below.



No. 2487½ Mechanical Joint Ends
Sizes†: 2 to 24-inch

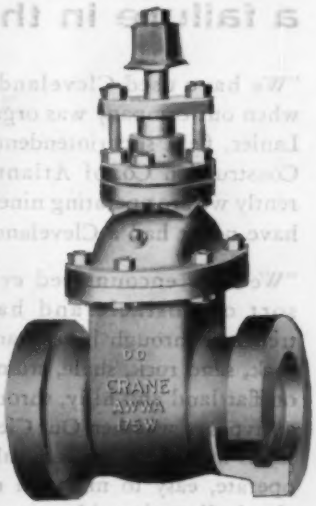


No. 2485 Flanged Ends
Sizes†: 2 to 24-inch



No. 480½ Hub Ends
Sizes†: 2 to 24-inch

No. 2482½ "Fluid-Tite" Ends—
Sizes: 3, 4, 6, 8, 10, 12-inch



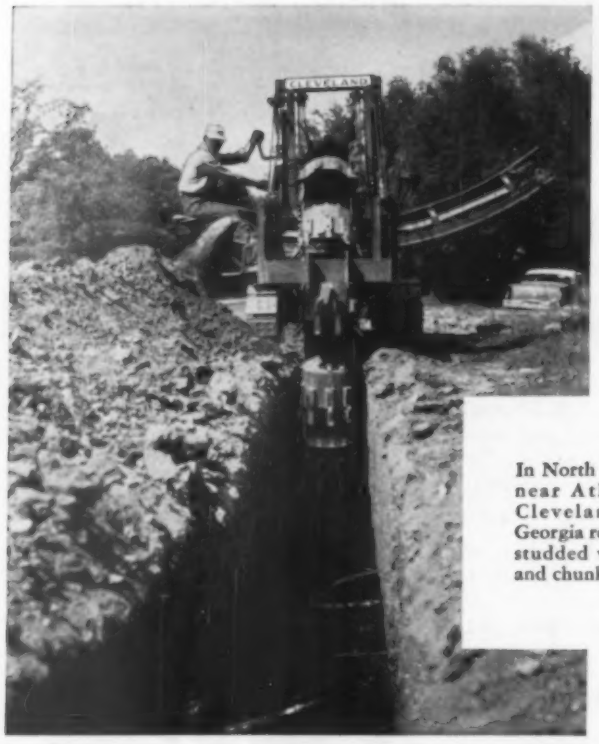
No. 2482½ "Ring-Tite" Ends—
Sizes: 3, 4, 6, 8, 10, 12-inch

Johns-Manville Asbestos Pipe
***Keasbey-Mattison Asbestos Pipe*
† Excludes 5-inch size
‡"Ni-Vee" is a registered trade-mark of the International Nickel Co.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers Serving All Areas



In North Druid Hills near Atlanta, this Cleveland 95 digs Georgia red clay, often studded with quartz and chunks of granite.

nine Clevelands . . . never a failure in the field

"We have used Clevelands ever since 1946, when our company was organized," says C. V. Lanier, field superintendent for the Concrete Construction Co. of Atlanta, Ga., "and currently we are operating nine. Mechanically, we have never had a Cleveland halt in the field.

"We have encountered every sort of obstacle and have trenched through blue granite rock, sand rock, shale, stumps, on flat land and hilly, through all types of weather. Our Clevelands have been economical to operate, easy to maintain mechanically, adaptable to every terrain and simple to handle."

There's nothing like a Cleveland for trenching . . . accurate . . . fast . . . dependable . . . clean.

The CLEVELAND TRENCHER Co.

20100 ST. CLAIR AVE. • CLEVELAND 17, OHIO

Good Everywhere ®

New Bulletins

CONTINUED FROM PAGE 24A

Dissolved Oxygen Analyzer

817

Beckman Process Instruments Div., Fullerton, Calif., has available a new four-page bulletin on the Beckman Model 70 Dissolved Oxygen Analyzer.

The Bulletin, a two-color illustrated brochure, gives comprehensive information on the Model 70 which has been designed for continuous, automatic analysis of dissolved oxygen in high purity water. Information includes application, specifications, principles of operation, instrument features which have eliminated shortcomings of previous methods of analysis, as well as a mounting dimensions diagram, a schematic diagram and photographs of the instrument.

Automatic Water Control Valves

818

Golden-Anderson Valve Specialty Company, Pittsburgh, Pa., has just published an 8-page bulletin describing nine different automatic water control valves and their uses. The bulletin describes the line that includes cushioned check valves, water level control valves, sensitive pressure regulators and one-man control valves. Sizes range from 2 inches to 36 inches, and the valves are manufactured for pressures up to 250 psi. Both angle and globe body patterns are available.

The bulletin contains several photographs of actual installations and gives a very interesting description of the part played by Golden-Anderson Cushioned Swing Check Valves in the launching of guided missiles at Cape Canaveral, Florida.

Nomograph For Sizing Chemical Feeding Systems

819

Milton Roy Co., Philadelphia, Pa., has developed and published a nomograph to assist design engineers determine the ideal capacities for the controlled volume pump and the chemical holding tank.

To use the nomograph, one must know the concentration of the chemi-

CONTINUED ON PAGE 106A

ON SLUDGE EIGHT YEARS..

And Still Closing Tight!

This DeZurik Valve was installed on a settled sludge line in Baltimore in *October, 1949.* It has been operated every day on sludge containing a high percentage of sand. Despite this tough service . . . without lubrication or any other maintenance in all that time . . . this DeZurik Valve still closes tight—is still performing without sticking, freezing or jamming!

While we're quite proud of this installation, it is not an isolated example. It reflects the punishment DeZurik Valves can take—are taking every day — and still stand up longer!

Wherever they're installed, DeZurik Valves gain friends—from maintenance men to consulting engineers, the men who *know* from performance records. They see, in case after case, DeZurik Valves take the toughest services (the easy ones, too) without failure, without expensive, continual maintenance, for years and years and years!

Get the complete story from the DeZurik representative in your area, see us in Booths 33 and 34 at the Detroit Sewage Show, October 5 to 9, or write to

DeZURIK CORPORATION
SARTELL, MINNESOTA

THE LOW-COST WAY TO LIFT SEWAGE

Duplex Ejector Twin Units for discharge rates of 30 to 500 g.p.m., heads up to 150 ft. Also made in single units.

THE BLACKBURN-SMITH WAY...

Simplest, most dependable, economical, sanitary. Automatic, unfailing electric, float and pneumatic controls. Compact. Lowest installation, operation, maintenance costs. Years of uninterrupted service. Hundreds in use, everywhere. Backed by 60 years of experience.

WRITE FOR CATALOG S-55

Shows application, advantages, dimensions and layouts of B-S Pneumatic Sewage Ejectors, single and duplex units. Describes exclusive features of float, electric and pneumatic controls. Tells how to select proper size ejector.

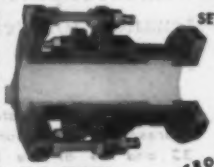
BLACKBURN-SMITH MFG. CO., INC.
51 GARDEN ST., HOBOKEN, N. J.
Oldfield 9-4425
N. Y. Tel. BArclay 7-0600

Crispin AIR VALVES

...for maximum safety and efficiency in pipeline operations

Crispin Air Valves have these basic advantages — simplified construction, easy accessibility, maximum durability, minimum maintenance and thoroughly efficient operation.

Crispin DEEP WELL AIR VALVES adjustable screw top attached to Crispin Air & Vacuum Valves controls air flow to eliminate damaging float flutter.



Crispin SEWER AIR VALVES automatic, not manual, control of air in equipment used for the treatment and disposal of sewage.

Crispin SLIP JOINTS safe, fast way to remove and replace fixtures when repairing lines.

AIR CONTROL VALVES FOR OVER 45 YEARS

multiplex
MANUFACTURING COMPANY
BERWICK, PENNSYLVANIA
Dept. B

Write, wire or phone for the facts on the complete line of Crispin Air Valves that provide safety and efficiency in your line operations.

New Bulletins

CONTINUED FROM PAGE 104A

cal solution to be metered, the required chemical dosage, and the flow rate of the process stream. Using this information to draw two straight lines on the nomograph, one will know the necessary pump capacity in gallons per hour and the number of gallons of tank holding capacity needed if the tank is to be refilled every 8, 12, 16, 24, 36 or 48 hours. The nomograph also gives the sizes of pumps that are 20, 50 or 100 per cent over capacity for when these margins of safety are desirable.

Published originally as an aid for Milton Roy's own application and field sales engineers, the nomograph has been printed on an 11 x 17 inch sheet so that results from use of its logarithmic scales will be consistent with standard engineering practice.

Pneumatic Transmission Lines

820

Bailey Meter Co., Cleveland, Ohio, has just published a 4-page product specification describing Armortube Cable, a flexible, armored, multiple tube transmission line for pneumatic and hydraulic metering and control systems.

Complete tables give sizes, shipping weights, tubing and protecting materials, dimensions, and installation information.

Sealed Register Water Meter

821

The Municipal and Utilities Div. of Rockwell Mfg. Co., Pittsburgh, Pa., has just published a new, multi-color, 20-page catalog describing the Rockwell Sealed Register meter.

Illustrations, drawings and color-photos supplement written material in describing the Sealed Register meter. Four pages are devoted to a complete parts list with illustrations and specifications.

According to the catalog, the principal features of the new water meter are: 1. an hermetically sealed register to end forever the problem of dirt, water and condensation that fogs dials,

CONTINUED ON PAGE 108A

All over the country more and more Sewage Treatment Plant Operators and Professional Sanitation Engineers say:

"Sure we were fooled once, but not again. Now we specify 'Cloroben', not 'Cloroben or equal'. Because we've learned the hard way that Cloroben has no equal!"

Only **CLOROBEN** has the precise formulation of chlorinated hydrocarbons processed in exactly right proportion with special and exclusive dispersing agents.

You find that the more difficult your odor or sanitation condition, the more definite the proof that **CLOROBEN** *is more than twice as effective as slightly cheaper substitute emulsifiable chlorobenzenes.*

To control odors and suppress sulfide formation in sewage, for septic tanks, cesspools, chemical toilets, no other product of its kind compares to **CLOROBEN** in safety, efficiency and true economy.

Specify and use **CLOROBEN**, and only **CLOROBEN**, for results you know you can depend on.

Yours on request: Technical Brochure, complete with evaluation and performance data, and describing **CLOROBEN** applications. Write Dept. WS-8

CLOROBEN CHEMICAL CORPORATION

115 Jacobus Avenue, South Kearny, New Jersey Subsidiary of Standard Chlorine Chemical Co., Inc.

GUNITE does it 2 times as fast at ½ the cost

"Gunite" is the modern process (sand and cement applied pneumatically) for repairing, constructing, lining:

- Reservoirs
- Dams
- Filter Plants
- Sewage Disposal Plants
- Tanks
- Stadiums
- Bridges
- Sea Walls
- Swimming Pools, etc.

WRITE FOR MORE INFORMATION, INCLUDING 48 PAGE "GUNITE" BOOKLET.

PRESSURE Concrete Co.

FLORENCE, ALA. 1555 Helton Street

OTHER OFFICES IN

CHICAGO, ILL. 30 W. Washington Street

NEWARK 5, N. J. 193 Emmet Street

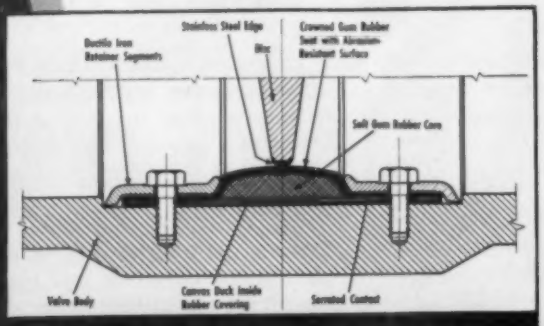
ROCKWELL-ENGINEERED AWWA BUTTERFLY VALVES

Most Advanced Design

Rockwell's new "Wedge-Lock" design meets and exceeds the most rigorous AWWA specifications for tight closure and long, trouble-free service.

In the valve's most vital part—the valve seat—the stainless steel-edged disc seats tightly against the crowned, abrasion-resistant surface of the multi-ply rubber seat. The entire seat insert is secured to the body by serrated contact with the retainer segments. The entire seat can be conveniently removed and replaced at site of installation.

Get Bulletin No. 581.



W. S. ROCKWELL COMPANY

2528 ELIOT STREET • FAIRFIELD, CONN.

Sales Representatives in Principal Cities

New Bulletins

CONTINUED FROM PAGE 106A

2. a powerful magnetic drive which eliminates the need for a stuffing box, an exposed intermediate train and a driving dog, and 3. the proven oscillating piston principle for a long life of accurate measurment.

The entire unit contains only 15 stock parts, of which only two moving parts operate in contact with water. Conventional water meters contain from 50 to 85 parts, of which not less than nine operate within water.

Valve Actuating Conversion Unit

B22

C. H. Wheeler Mfg. Co., Philadelphia, Pa., has published a four-page two-color catalog describing a new automatic valve actuating conversion unit.

The new catalog explains the six steps in the installation of the unit and illustrates each with photographs. Design, metallurgy, and maximum pressure differential data as well as a cross-section diagram of the unit are all included in the catalog.

Ductile Iron Pipe Fittings

B23

Kuhns Brothers Co., Dayton, Ohio, has released a new 8-page illustrated catalog giving complete data on ductile iron pipe fittings.

The catalog includes types and sizes of the "K" line of ductile iron fittings, typical applications, prices, safety factors and service ratings as listed by Underwriters' Laboratories, Inc.

It also includes comparative physical properties of various pipe fittings metals and explains the production control tests used by Kuhns to assure uniform quality in manufacturing.

The catalog also contains data on impact testing. Another section describes the following specifications which are met or exceeded by these fittings: A.M.S., A.S.T.M., Ordnance, Navy, Coast Guard, Corps of Engineers and the National Board of Fire Underwriters.

112

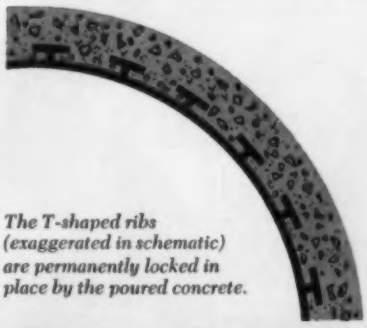
This Sewer will go a Long Way

Not only will this 9½-foot outfall sewer extend eight miles, but it will go a long way in years of trouble-free service. The engineers who designed it say that it will still be functioning perfectly in the year 2000.

Their confidence is based on wise choice of construction materials. Every joint of pipe, every foot of monolithic tunnel, every structure is built of reinforced concrete to obtain structural strength at low cost. Every surface above the low flow line is completely covered by a continuous membrane of T-Lock Amer-Plate®, the vinyl lining that is impervious to the corrosive action of oxidized hydrogen sulfide *at any level of concentration.*

The engineers know that no one can accurately predict future rates of H_2S gas generation, so they have insured the ultimate life of the concrete by investing an extra 8 to 10% for T-Lock protection. They predict that this "extra" will spare their city the cost of a replacement sewer in about 20 years, and *save the taxpayers millions of dollars!*

Because of obvious and substantial savings such as this, millions of square feet of T-Lock are now in use in progressive municipalities from coast to coast. These include Los Angeles; Topeka; Wichita; Sioux City; Shreveport; Washington, D.C.; San Diego; Mansfield, Ohio; Huntington, W.Va.; Hutchinson, Kan.; and Orange County, Calif. T-Lock Amer-Plate is also on current specifications for many other municipalities. For complete list of users and specifiers, plus technical data and a typical specification, write:



The T-shaped ribs (exaggerated in schematic) are permanently locked in place by the poured concrete.

There is no limitation on size or shape of structures which may be protected with T-Lock Amer-Plate.

Amercoat® CORPORATION

Dept. W.H.
4809 Firestone Blvd.
South Gate, California

Evanston, Ill. • Kenilworth, N. J. • Jacksonville, Fla. • Houston, Texas

Helpful Bulletins *Available Free*

Area Meter Transmitter

824

Bailey Meter Company, Cleveland, Ohio, has just published a 4-page Product Specification folder on the application of Bailey Area Meter Pneumatic Transmitter to flow measurement of water, gasoline, oil, tar, chemicals, and distillates.

Write Today For 108 Page Catalog
W. S. DARLEY & CO. Chicago 12

Underground Pumping Stations

825

Zimmer & Francescon, Moline, Ill., has released an eight-page bulletin describing the completely prefabricated Z-F Underground Pump.

Armored Rotameters

826

Brooks Rotameter Co., Lansdale, Pa., has just released a new bulletin that describes armored Ar-Met rotameters designed for pressures up to 5000 psi and for flow rate equivalents up to 3000 GPM of water.

Two-Column Gas Chromatography

827

Beckman Scientific Instruments Div., Fullerton, Calif., has just published a 4-page Data Sheet that describes and illustrates the time-saving benefits of two-column gas chromatography.

Automatic Transfer Switches

828

Automatic Switch Co., Florham, N. J., has available a booklet on how to select an automatic transfer switch, and applications of this equipment.

Water Filtration Plant Catalog

829

Dresser Mfg. Div., one of the Dresser Industries, Inc., Bradford, Pa., has just published a new Water Filtration Plant Catalog.

This new 8-page catalog describes the uses of Dresser Couplings on filtration plant piping in modern water treatment plants in actual operation today.

Flowmeter Selection

830

Fischer & Porter, Hatboro, Pa., has released a Technical Bulletin, on "How to Select Flowmeters," that gives criteria for choosing the type of flowmeter to be used in measuring a given fluid or liquid. Advantages and limita-

Turbidity Transmitter

831

Bailey Meter Co., Cleveland, Ohio, has published a 4-page Product Specification that ilustrates and describes how turbidity measurements are electrically transmitted to remote indicators, and/or recorders by the Bailey Bolometer Transmitter. Details of

Airmerge Blending System

832

Fuller Co., Catasauqua, Pa., has published a 16-page technical bulletin, describing the new Airmerge System for the exact blending of dry pulverized materials.

Steel-Plastic Pipe

833

Jones & Laughlin Steel Corp., Pittsburgh, Pa., has just released a four-page pamphlet containing information about a newly-developed rigid plastic pipe encased in a steel jacket.

Trenchliner Versatility

834

Parsons Co., Newton, Iowa, has just published a 12-page catalog emphasizing the versatility and ruggedness of the Parsons 310 Trenchliner.

K-S PNEUMATIC SEWAGE EJECTORS . .
. . SERVICE *backed by* EXPERIENCE

Komline-Sanderson experience, gained in the design, manufacture and installation of sewage handling equipment, guarantees the service offered with each K-S Sewage Ejector System. Sizes from 30 to 600 GPM capacities—single or duplex units. Construction—cast iron or steel. Pneumatic or electrode controlled.

Write for new 14-page catalog No. KSM-2

MECHANICAL EQUIPMENT DIVISION
KOMLINE-SANDERSON ENGINEERING CORPORATION
102 Holland Avenue, Peapack, New Jersey

Consulting Engineers *IN WATER & SEWAGE WORKS*

ALBRIGHT & FRIEL INC.

Consulting Engineers

Water, Sewage, Industrial Wastes and Incineration Problems—City Planning, Highways, Bridges and Airports—Dams, Flood Control, Industrial Buildings—Investigations, Reports, Appraisals and Rates—Laboratory for Chemical & Bacteriological Analyses—Complete Service on Design and Supervision of Construction.

Three Penn Center Plaza
Philadelphia 2, Pa.

Bowe, Albertson & Associates

Engineers

Water and Sewage Works—Industrial Wastes—Refuse Disposal—Municipal Projects—Industrial Buildings—Reports—Plans—Specifications—Supervision of Construction and Operation—Valuations—Laboratory Service

75 West Street New York 6, New York

CAPITOL ENGINEERING CORPORATION

Engineers—Constructors—Management

SEWAGE SYSTEMS	WATER WORKS
Designs and	Roads and
Surveys	Streets
Planning	Airports
Bridges	Dams

Executive Offices
DILLSBURG, PENNSYLVANIA

Alvord, Burdick & Howson

Engineers

Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation

20 N. Wacker Drive, Chicago 6, Ill.

BOYLE ENGINEERING

Consulting Engineers

Water—Sewers—Streets
Structures—Surveys
Reports—Special Districts

331 Spurgeon Bldg. Santa Ana, Calif.
3913 Ohio, Rm. 200 San Diego 4, Calif.

The Chester Engineers

Water Supply and Purification—Sewage and Industrial Waste Treatment—Power Plants—Incineration—Gas Systems—Valuations—Rates—Management—Laboratory—City Planning

601 Seusmon Street
Pittsburgh 12, Penna.

JOHN J. BAFFA

Consulting Engineer

Water Supply and Treatment
Sewerage and Sewage Treatment

75 West Street New York 6, N. Y.

Brockway, Weber & Brockway Engineers

INCORPORATED

George S. Brockway — Ray E. Weber
George B. Brockway

STAFF

H. L. Fitzgerald, T. A. Clark, B. E. Whittington, R. E. Owen, John Adair, Jr., C. A. Anderson, T. B. Demery

Civil, Structural, Sanitary, Municipal, Electrical
West Palm Beach, Florida

Chas. W. Cole & Son

Engineers — Architects

Sewerage, Water Supply, Bridges, Highways, Toll Roads, Industrial, Municipal and Commercial Buildings

220 W. LaSalle Ave., South Bend, Indiana
Central 4-0127

MICHAEL BAKER, JR., INC.

The Baker Engineers

Civil Engineers, Planners, and Surveyors

Airports, Highways, Sewage Disposal Systems, Water Works Design and Operation—City Planning—Municipal Engineering—All types of Surveys

Home Office: Rochester, Pa.
Branch Offices:
Jackson, Miss. Harrisburg, Pa.

Buck, Seifert and Jost

Consulting Engineers

Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design Construction Operation Management, Chemical and Biological Laboratories

112 East 19th St. New York

CONSOER, TOWNSEND & ASSOCIATES

Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports Traffic Studies, Airports, Gas & Electric Transmission Lines.

360 East Grand Ave. Chicago 11, Ill.

Betz Laboratories, Inc.

CONSULTING ENGINEERS

INDUSTRIAL WASTE
INDUSTRIAL WATER

ANALYSIS DESIGN
INVESTIGATIONS OPERATION

Gillingham & Worth Sts.
Philadelphia 24, Pa.

BURGESS & NIPLE

Civil and Sanitary Engineers

Water Supply and Purification
Sewerage and Sewage Treatment
Appraisals, Reports, Valuations

2015 West Fifth Avenue
Columbus 12, Ohio

CARL C. CRANE, Inc.

CONSULTING ENGINEERS

2702 MONROE ST.

MADISON 5, WISCONSIN

BLACK & VEATCH

Consulting Engineers

Sewage—Waste Disposal—Water
Electricity—Industry

Reports, Design, Supervision of Construction, Investigations, Valuations and Rates

1500 Meadow Lake Parkway
Kansas City 14, Missouri

BURNS & McDONNELL

Engineers—Architects—Consultants

KANSAS CITY, MO.
P.O. Box 7088
Phone: DElmar 3-4375

MR. CONSULTING ENGINEER

Are you interested in both

WATER & SEWAGE

If so there is no better place for your professional card than in this dual interest magazine.

Water & Sewage Works

BOGERT AND CHILDS

CONSULTING ENGINEERS

Clinton L. Bogert, Fred S. Childs
Ivan L. Bogert, Donald M. Ditmars
Robert A. Lincoln, Charles A. Manganaro
William Martin

Water & Sewage Works • Refuse Disposal • Drainage • Flood Control • Highways and Bridges • Airfields

145 East 32nd Street, New York 16, N. Y.

Camp, Dresser & McKee

Consulting Engineers

6 Beacon Street, Boston 8, Mass.

Water Works and Water Treatment; Sewerage and Sewage Treatment; Municipal and Industrial Wastes; Investigations and Reports; Design and Supervision; Research and Development; Flood Control.

ROY B. EVERSON

Water Treatment Service Since 1900 for Swimming Pool Circulating Systems. Purification Systems as applied to Sewage Treatment and Water Works. A New System for Automatic Control.

233 W. Huron Street, Chicago 10, Ill.

Additional Engineers Cards on Next Page

ENGINEER ASSOCIATES
Consulting Engineers
Sewage Disposal Systems, Water Works Design, Airports, Highways and Bridges, City Planning & Engineering for Building Design
312 N. W. Eighth St.
Evansville, Indiana

FAY, SPOFFORD & THORNDIKE, Inc.
Engineers
Water Supply and Distribution—Drainage
Sewerage and Sewage Treatment
Airports—Bridges—Turnpikes
Port and Terminal Works—Industrial Bldgs.
Investigations, Reports, Designs, Valuations
Supervision of Construction
11 Beacon Street, Boston 8, Mass.

FINKBEINER, PETTIS & STROUT
Carleton S. Finkbeiner — Charles E. Pettis
Harold K. Strout
CONSULTING ENGINEERS
Water Supply, Water Treatment, Sewerage, Sewage Treatment, Wastes Treatment, Bridges, Highways & Expressways
2130 Madison Avenue — Toledo 2, Ohio

Freese & Nichols
FORT WORTH, TEXAS
Freese, Nichols & Turner
HOUSTON, TEXAS
Industrial and Municipal Engineering—Water Supply and Purification—Sewerage and Industrial Waste Treatment—Highways and Structures—Dams—Drainage Works—Airports—Investigations—Valuation—Design and Supervision

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Engineers
HARRISBURG, PA.
Pittsburgh, Pa. — Daytona Beach, Fla.
Philadelphia, Pa.
Water Works, Sewage, Industrial Wastes and Garbage Disposal—Roads, Airports, and Garbage Disposal—Roads, Airports, Bridges, Flood Control, Traffic & Parking, Appraisals, Investigations & Reports.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Water Supply and Purification
Sewage and Industrial Waste Treatment
Chemical Laboratory Service
Investigations and Reports
New York — Reading, Pa. — Washington
Houston — Philadelphia

GLACE AND GLACE
Consulting Sanitary Engineers
WATER SUPPLY AND PURIFICATION
SEWERAGE AND SEWAGE TREATMENT
Design, Construction and Supervision of Operation
2771 Paxton Street — Harrisburg, Pa.

GREELEY AND HANSEN
Engineers
Samuel A. Greeley — Paul Hansen (1920-1944)
Paul E. Langdon — Kenneth V. Hill
Thomas M. Niles — Samuel M. Clarke
Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal
220 S. State Street, Chicago 4

HASKINS, RIDDLE & SHARP
Consulting Engineers
Water—Sewage & Industrial Wastes—Hydraulics
Reports, Design, Supervision of Construction
Appraisals, Valuations, Rate Studies
1009 Baltimore Ave. — Kansas City 5, Mo.

HAVENS AND EMERSON
A. A. BURGES
HARRY H. MOSELEY — J. W. AVERY
FRANK S. PALOCSAY — EDWARD S. ORDWAY
FRANK C. TOLLES, CONSULTANT
CONSULTING ENGINEERS
WATER, SEWERAGE, GARBAGE, INDUSTRIAL WASTES VALUATIONS—LABORATORIES
LEADER BLDG. CLEVELAND 14, O. — WOOLWORTH BLDG. NEW YORK 7, N. Y.

Hayden, Harding & Buchanan, Inc.
Consulting Engineers
John L. Hayden
John H. Harding — Oscar J. Compto
Waterworks, Sewerage, Civil, Mechanical, Electrical, Structural
1340 Soldiers Field Road, Boston 35, Mass.

HAZEN AND SAWYER
ENGINEERS
Richard Hazen — Alfred W. Sawyer
H. E. Hudson, Jr.
Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control
122 East 42nd St. New York 17, N. Y. — 3333 Book Building Detroit 26, Mich.

HENNINGSON, DURHAM & RICHARDSON
Consulting Engineers since 1917 for more than 700 cities and towns.
Water Works, Light and Power, Sewers, Sewage Treatment, Reports, Flood Control, Appraisals, Drainage, Paving.
2962 Harney St., Omaha 2, Nebraska

The Jennings-Lawrence Co.
Civil & Municipal Engineers
Consultants
Water Supply, Treatment & Distribution
Sewers & Sewage Treatment
Reports—Design—Construction
1392 King Ave. — Columbus 12, Ohio

Jones, Henry & Williams
Consulting Sanitary Engineers
Water Works
Sewerage & Treatment
Waste Disposal
821 Security Bldg. — Toledo 4, Ohio

Engineering Office of CLYDE C. KENNEDY
SANITARY ENGINEERING
SAN FRANCISCO

LANNING
Sanitary Engineering Co., Inc.
Consulting Engineers
Professional Building
1100 South Broad Street
Trenton — New Jersey

LOCKWOOD GREENE ENGINEERS, INC.
Architects - Engineers
Montgomery Building
SPARTANBURG, S. C.
Water Supply—Power Plants
Sewage Disposal—Valuations & Appraisals
Industrial Waste—Industrial Plant Design

WM. S. LOZIER CO.
Sewerage, Sewage Disposal, Water Supply, Water Purification
Refuse Disposal
Consulting Engineers
10 Gibbs Street — Rochester 4, N. Y.

Morris Knowles, Inc.
Engineers
Water Supply and Purification, Sewerage and Sewage Disposal Valuations, Laboratory, City Planning
1312 Park Building, Pittsburgh, Pa.

Metcalf & Eddy
Engineers
Water, Sewage, Drainage, Refuse and Industrial Waste Problems
Airports — Valuations
Laboratory
Statler Building, Boston 16

O'BRIEN & GERE
Consulting Engineers
Water Supply, Treatment and Distribution
Sewerage and Sewage Treatment
Industrial Waste Treatment—Flood Control and Drainage—Rate Studies
400 East Genesee Street — Syracuse 2, N. Y.

PARSONS, BRINCKERHOFF HALL & MACDONALD
G. Gale Dixon, Associate
Civil and Sanitary Engineers
Water, Sewage, Drainage and Industrial Waste Problems.
Structures—Power—Transportation
165 Broadway — New York 6, N. Y.

MALCOLM PIRNIE ENGINEERS
Malcolm Pirnie — Ernest W. Whitlock
Robert D. Mitchell — Carl A. Arenander
Malcolm Pirnie, Jr.
MUNICIPAL AND INDUSTRIAL
Water Supply—Water Treatment
Sewage and Waste Treatment
Drainage—Sewerage—Refuse Disposal
25 West 43rd St. — New York 36, N. Y.

Additional Engineers Cards on Next Page

THE PITOMETER ASSOCIATES, INC.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurements & Special Hydraulic Investigations
New York, 50 Church Street

ROBERT AND COMPANY ASSOCIATES
Engineering Division
ATLANTA

Alden E. Stilson & Associates
Limited
Consulting Engineers
Water Supply—Sewage—Waste Disposal
Bridges—Highways—Industrial Buildings
Studies—Surveys—Reports
2060 E. 9th Street, Cleveland 15, Ohio

LEE T. PURCELL
Consulting Engineers
Water Supply & Purification; Sewerage & Sewage Disposal; Industrial Wastes; Investigations & Reports; Design; Supervision of Construction & Operation
Analytical Laboratories
38 De Grasse Street, Paterson 1, N. J.

MR. CONSULTING ENGINEER
Are you interested in both
WATER & SEWAGE
If so there is no better place for your professional card than in this dual interest magazine.
Water & Sewage Works

Weston & Sampson
Water Supply, Water Purification, Sewerage, Sewage and Industrial Waste Treatment, Corrosion Control, Laboratory Service Supervision, Valuations
14 Beacon St., Boston, Mass.

Rader and Associates
Consulting Engineers
Water Works, Sewers, Refuse Disposal and Other Public Works Engineering Reports, Investigations, Consultations, Plans, Specifications and Supervision of Construction Work
111 N.E. 2nd Avenue, Miami 32, Florida

Benjamin L. Smith & Associates
Engineers
Investigations—Reports
Designs—Supervision—Valuations
Municipal Engineering and Public Utilities
11 North Pearl Street
Albany 7, New York

Whitman & Howard
Engineers (Est. 1869)
Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.
89 Broad St., Boston, Mass.

Thomas M. Riddick
Consulting Engineer and Chemist
Municipal and Industrial Water Purification, Sewage Treatment, Plant Supervision, Stream Pollution Investigations, Chemical and Bacteriological Analyses.
369 East 149th Street
New York 55, N. Y.

STANLEY ENGINEERING COMPANY
Consulting Engineers
Hershey Building, Muscatine, Iowa
208 S. LaSalle St., Chicago 4, Ill.

WHITMAN, REQUARDT & ASSOCIATES
Engineers—Consultants
Civil—Sanitary—Structural—Mechanical—Electrical
Reports, Plans, Supervision, Appraisals
1304 St. Paul Street
Baltimore 2, Maryland

THE Martinique
THE NEW LOOK IN NEW YORK

Sparkling new interiors—superb new furnishings—striking new decor! Ideally located in the great Penn Zone Times Square, Radio City, Rockefeller Plaza, theater district, and famous Fifth Avenue shops less than 5 minutes away. Lobby connects with Penn Railroad and Greyhound Bus terminals, and Hudson-Manhattan Tubes to Jersey. 650 luxurious rooms—radio, television, air-conditioning available. All hotel services.

from $5 single $8.50 double

CONVENTION FACILITIES

NEW MARTINIQUE LOUNGE COFFEE SHOP

BROADWAY AT 32nd STREET **New York City**
Telephone PEnnsylvania 6-3800

Tops in Everything
ONVENIENT

Ideally located in St. Louis, two short blocks from the Union Station and in the center of the Wholesale District . . . Preferred, always by experienced travelers because of its outstanding advantages— Every room with combination tub and shower . . . and circulating ice water. Delicious food . . . cheerful service.

AIR-CONDITIONED ROOMS
350 rooms from $3.50

HOTEL **LARIDGE**
LOCUST ST. AT EIGHTEENTH
Free Parking
ST. LOUIS

ERNIE SIMONS
General Manager

Prestressed Concrete Tanks Show Big Savings

Maintenance Costs Cut By 75%

Over a 50 year service life, a prestressed concrete tank will show a 75% saving in total maintenance costs over a steel tank of the same capacity. In today's economy, such a long range saving has tremendous appeal to municipalities and water companies throughout the world. When your tank requirements are in the planning stage, these calculated maintenance costs should be considered. Average yearly maintenance on a 3,000,000 gallon steel tank is estimated at $2500 per year at current prices. For a prestressed concrete tank, maintenance is negligible; however, occasional painting for color effect may be desired.

When the charges for servicing the initial cost plus relative maintenance allowances are plotted, the prestressed

concrete tank will often show a lower out of pocket cost to the owner in less than 5 years. When these costs and their increases are extended for an expected service life of 50 years, the savings to the owner with prestressed concrete are enormous.

The prestressed concrete tank is also a good looking tank . . . it is inherently strong and extremely stable . . . it is designed and built for permanence.

And, 75% of the contract price is spent right in your local community . . . construction is done with materials and labor available locally.

Write today for more information on Preload Prestressed Concrete Tanks.

THE PRELOAD COMPANY, INC.
211 East 37th Street
New York 16, New York

PRELOAD CONCRETE STRUCTURES, INC.
837 Old Country Rd., Westbury, L. I., N. Y.

PRELOAD MIDWEST CONSTRUCTION CO.
2211 East 19th Street, Kansas City, Mo.

HERRICK IRON WORKS
28400 Clawiter Road, Hayward, California

THE PRELOAD COMPANY, INC.
Jefferson Tower Bldg., 351 Jefferson, Dallas, Tex.

THE CANADA GUNITE COMPANY, LTD.
7325 Decarie Boulevard, Montreal 16, Canada

Advertisers Index

A

*Alabama Pipe Co. 11A
*Amercoat Corp. 109A
American Pipe Construction Co. 11A
*Anthracite Equipment Corp. 94A

B

Badger Meter Mfg. Co. 25A-26A-27A-28A-29A-30A
Blackburn-Smith Mfg. Co. 106A
*B-I-F Industries, Inc. ..... 99A-Back Cover
*Builders-Providence, Inc. ..... 99A-Back Cover

C

Calgon Co. 44A
Cast Iron Pipe Research Ass'n. 34A-35A
Chapman Valve Mfg. Co. 36A-37A
*Chicago Bridge & Iron Co. 6A
*Chicago Pump Company 91A
*Cleveland Trencher Co., The 104A
Cloroben Chemical Corp. 107A
*Combustion Engineering 40A
*Clow & Sons, James B. 45A
*Columbia Southern Chemical Co. 101A
Crane Co. 103A

D

Darley & Co., W. S. 110A
DeZurik Shower Company 105A
*Dorr-Oliver ..... Inside Back Cover

E

Electro-Rust Proofing Corp. 24A
Ellis & Ford Mfg. Co. 100A

F

*Fischer & Porter Co. 38A
Ford Meter Box Co. 22A

G

Gar Wood Industries, Inc. 102A
General Services 100A

H

Hamilton Kent Mfg. Co. 33A
Healy-Ruff Company 94A
Hersey Manufacturing Company 39A

I

*Iowa Valve Co. 10A

K

*Komline-Sanderson Engr. Corp. 110A
Kuhns Bros. Co. 17A

L

Layne & Bowler, Inc. 23A
*Leopold & Co., F. B. 5A

M

*M & H Valve & Fittings Co. 15A
*Mueller Company 95A-96A-97A-98A
*Multiplex Mfg. Co. 106A

N

*National Clay Pipe Mfrs., Inc. 1A
*Neptune Meter Company 46A
Nordstrom Valve Co. 108A

O

*Omega Machine Co. ..... 99A-Back Cover

P

*Pacific Flush Tank Company 16A
*Permutit Company 2A
*Phipps & Bird, Inc. 100A
*Pratt Co., Henry 4A
Preload Company 114A
*Pressure Concrete Co. 108A
Price Bros. Company 14A

R

*Roberts Filter Co. 94A
Rockwell Co., W. S. 108A

S

*Simplex-Valve & Meter Co. 41A
*Smith, S. Morgan 20A
Standard Dry Wall Products Co. 21A

U

U. S. Electrical Motors, Inc. 19A
*U. S. Pipe & Foundry Co. 42A-43A
U. S. Rubber 8A

W

Waukesha Motor Co. 12A-13A
Weinman Pump Mfg. Co. 92A
W K M Mfg. Co.
Div. of A. C. F. Industries. ..... Inside Front Cover
Wood Co., R. D. 32A

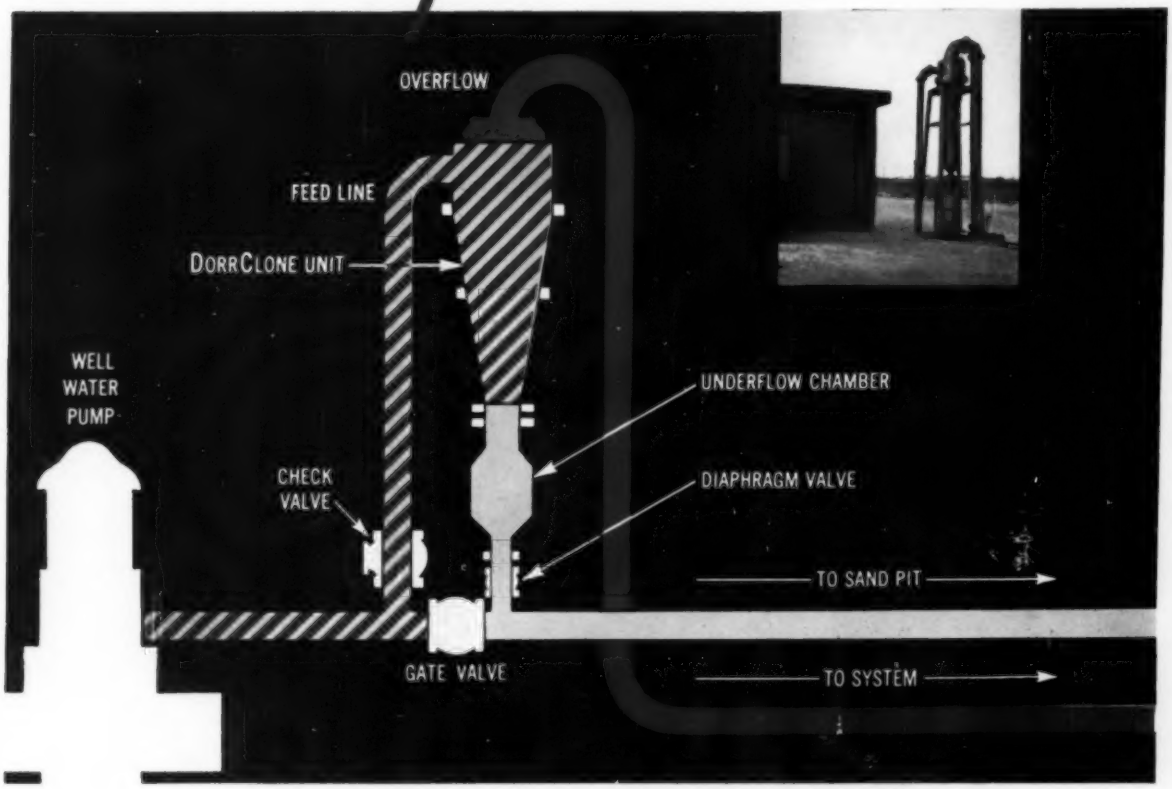
Y

*Yeomans Bros. 93A

*Advertisers represented in the 1957 Reference and Data Number with Catalog specifications copy. Please refer to that issue for additional information concerning their product or equipment.

IT'S NEW

It's from DORR-OLIVER



DORRCLONE DESANDING SYSTEM FOR WELL WATER

Continuous, positive removal of practically all undesirable sand and silt – without use of any power other than pressure supplied by the pump! That's what you get with the new DorrClone desanding system! It's today's simplest, lowest cost, most practical method of desanding well water—pays for itself over and over by reducing sanded mains, excessive wear and plugging of meters and abrasion of appliances.

Heart of the system is in the DorrClone unit, a cylindro-conical shell, shown diagrammatically above. In operation, raw feed water enters tangentially under pressure at the top. A vortex action is created, throwing sand particles to the walls of the cone and down to the underflow at the bottom. Sand-free water at the center of the vortex flows out the top to storage, a treatment plant, or directly to the mains.

The simplicity of the DorrClone desanding system is demonstrated in the installation at Hobbs, New Mexico, shown in the small photo. Units may be designed to suit practically all well water systems. For full information, write for a copy of Bulletin No. 2507.

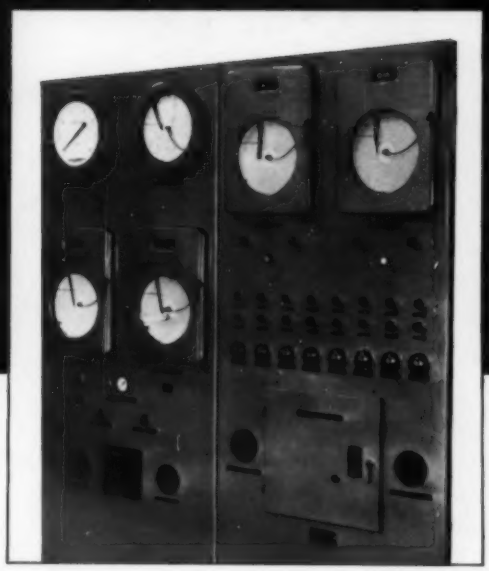
DorrClone, T.M. Reg. U.S. Pat. Off.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

POSITIVE CONTROL OF MATERIALS IN MOTION B-I-F METERS FEEDERS CONTROLS

Push One Button...

AUTOmatic CENTRALized Filter Operation



- Reduces Operating Costs!
- Reduces Operation Time!
- Eliminates Human Errors!

HERE'S HOW...

Builders Auto-Central® Filter Backwash Control Systems contribute to economical plant operation.

Pressing the "start" button initiates the backwash cycle. This automatically sequences the valves to drain filter . . . applies backwash and surface wash flows in precisely regulated quantities . . . and returns filter to service at end of cycle. A high speed recorder eliminates the need for log entries and computations. Thus operator is released for other more important duties . . . operating time and costs are reduced . . . human error is eliminated!

Other Builders Auto-Central advantages include:

- lower initial cost . . . more economical arrangement of physical plant.
- optimum filter operation . . . more accurate, precise control of filter backwash cycle . . . automatically.
- greater reliability . . . human error eliminated.

Builders ONE SOURCE – ONE RESPONSIBILITY combination of equipment, service and experience is always available to aid you in solving any water, sewage or waste treatment problem. Write for Bulletin 480-L1 . . . to **Builders-Providence, Inc., 374 Harris Ave., Prov. 1, R. I.**

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES B-I-F METERS FEEDERS CONTROLS